Singer

TG-1

op-sv

Singer
16-1
dp-sv

GERTSCH / SINGER
Model TG-1
Universal Tone Generator

3

# WARRANTY

THE SINGER COMPANY, LOS ANGELES OPERATION, (SELLER) warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

| | |
|---|---|
| TCXO Oscillator | 2 Years |
| Electrical and Electronic Measuring Instruments | 1 Year |

Repair or replacement (at our option) without charge (F.O B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and RatioTran potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other warranties, express or implied INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, or fitness for a particular purpose. In no event shall the SELLER be liable for INCIDENTAL OR CONSEQUENTIAL damages. The SELLER neither assumes, nor authorizes any person to assume for it, any other liability in connection with sales of instruments manufactured by SELLER.

With respect to repairs, the foregoing warranty shall apply for a period of ninety days to the repaired portion.

**THE SINGER COMPANY, LOS ANGELES OPERATION**
5340 Alla Road, Los Angeles, California 90066

---

## REPAIR AND MAINTENANCE

Instruments should be returned only on prior authorization from the Singer Representative or the factory. You will be advised of detailed shipping instructions at that time. Return the instrument to the factory Prepaid. Validity of warranty will be determined by the factory.

Chargeable repairs: If requested, an estimate of charges will be made prior to repairs. Please provide us with the following information in order to expedite the processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(1)
4. Approximate date instrument was placed in operation.
5. Approximate number of hours in use.
6. Has maintenance action been previously requested.
7. Other comments.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

CONTENTS


| Section | | | Page |
|---|---|---|---|
| I | INTRODUCTION | | 1-1 |
| | 1.1 | General | 1-1 |
| | 1.2 | Tone Formats | 1-1 |
| | 1.3 | Models Available | 1-1 |
| | 1.4 | Applications | 1-3 |
| II | OPERATING INSTRUCTIONS | | 2-1 |
| | 2.1 | Introduction | 2-1 |
| | 2.2 | Modes of Operation | 2-1 |
| | 2.3 | Turn-On Transients | 2-1 |
| | 2.4 | Operating Procedures | 2-7 |
| | | 2.4.1 Continuous - Single Tone | 2-7 |
| | | 2.4.2 Continuous Two-Tone Simultaneous | 2-7 |
| | | 2.4.3 Continuous Three-Tone Simultaneous | 2-7 |
| | | 2.4.4 Single Burst - Single Tone | 2-7 |
| | | 2.4.5 Single Burst - Two Tone Simultaneous | 2-8 |
| | | 2.4.6 Single Burst - Three-Tone Simultaneous | 2-8 |
| | | 2.4.7 Sequential Bursts, f1→f2 | 2-9 |
| | | 2.4.8 Sequential Bursts [f1, f3]→[f2, f4] | 2-9 |
| | 2.5 | Secode Testing (Ref. to Appendix A for Upgrading TG-1B for IMTS, MTS and SECODE.) | 2-10 |
| | 2.6 | IMTS Testing (Ref. to Appendix A for Upgrading TG-1B for IMTS, MTS and SECODE.) | 2-11 |
| | 2.7 | MTS Testing (Ref. to Appendix A for Upgrading TG-1B for IMTS, MTS and SECODE.) | 2-12 |
| | 2.8 | Independent Tone Level Adjustments | 2-15 |
| | | 2.8.1 Preliminary Procedure | 2-15 |
| | | 2.8.2 Frequency f1 Level Adjustment | 2-15 |
| | | 2.8.3 Frequency f2 Level Adjustment | 2-15 |
| | | 2.8.4 Frequency f3 Level Adjustment | 2-16 |
| | | 2.8.5 Frequency f4 Level Adjustment | 2-16 |
| | | 2.8.6 Frequency f'2 Level Adjustment | 2-17 |

CONTENTS - Continued


| Section | | | Page |
|---|---|---|---|
| | 2.9 | Remote Control | 2-17 |
| | 2.10 | Cascading | 2-17 |
| | | 2.10.1 Single Cycle | 2-18 |
| | | 2.10.2 Repeat Cycle | 2-18 |
| III | | THEORY OF OPERATION | 3-1 |
| | 3.1 | General | 3-1 |
| | 3.2 | Frequency Synthesis Circuits (Refer to Figure 3-1) | 3-1 |
| | | 3.2.1 Multiplexing | 3-2 |
| | | 3.2.2 Output | 3-2 |
| | 3.3 | Control Logic Circuits | 3-5 |
| | | 3.3.1 Timing Circuits | 3-5 |
| | | 3.3.2 Modes of Operation | 3-5 |
| | | 3.3.3 Repeat Cycling Circuits | 3-5 |
| | | 3.3.4 Start Circuit | 3-6 |
| | | 3.3.5 Stop Circuit | 3-6 |
| IV | | MAINTENANCE | 4-1 |
| | 4.1 | Introduction | 4-1 |
| | 4.2 | Test Equipment | 4-1 |
| | 4.3 | Power Supply Adjustment | 4-1 |
| | 4.4 | Test and Adjustment Procedures for Frequency Synthesizer Boards | 4-2 |
| | | 4.4.1 Frequency Synthesizer Board, A1 | 4-2 |
| | | 4.4.1.1 Triangularity Check | 4-2 |
| | | 4.4.1.2 Triangularity Adjustment Procedure | 4-2 |
| | | 4.4.1.3 Distortion Check and Adjustment | 4-4 |
| | | 4.4.2 Frequency Synthesizer Board, A2 | 4-4 |
| | | 4.4.3 Frequency Synthesizer Board, A3 | 4-4 |
| | 4.5 | Timing Check and Adjustment Procedures | 4-5 |
| | | 4.5.1 First Burst (set pause, second burst, and repeat delay to minimum) | 4-5 |
| | | 4.5.2 Pause | 4-5 |

CONTENTS - Continued


| Section | | | Page |
|---|---|---|---|
| | | 4.5.3 Second Burst | 4-6 |
| | | 4.5.4 Repeat Delay | 4-7 |
| | 4.6 | Frequency Accuracy Test | 4-8 |
| | | 4.6.1 Frequency f1 Test (all models) | 4-8 |
| | | 4.6.2 Frequency f2 Test (TG-1B, and TG-1C only) | 4-8 |
| | | 4.6.3 Frequency f3 Test (TG-1B, and TG-1C only) | 4-9 |
| | | 4.6.4 Frequency f4 Test (TG-1B, and TG-1C only) | 4-9 |
| V | | SCHEMATIC DIAGRAMS | 5-1 |
| VI | | PARTS LIST | 6-1 |
| Appendix | | | |
| A | | INSTALLATION PROCEDURE FOR UPGRADING TG-1 | A-1 |
| | A.1 | Introduction | A-1 |
| | A.2 | Upgrading TG-1A to TG-1B | A-1 |
| | A.3 | Upgrading TG-1A to TG-1C | A-1 |
| | A.4 | Upgrading TG-1B to TG-1C | A-2 |
| | A.5 | Upgrading TG-1A, B or C to Programmable Unit | A-2 |
| | A.6 | Upgrading TG-1B for IMTS, MTS and Secode Output | A-2 |

## TABLES


| Table | | Page |
|---|---|---|
| 1-1 | Tone Formats | 1-2 |
| 1-2 | Specifications | 1-4 |
| 2-1 | Front Panel Operating Controls, Indicators and Connectors TG-1 (Keyed to Figure 2-1) | 2-3 |
| 2-2 | Rear Panel Controls and Connections (Keyed to Figure 2-2) | 2-5 |
| 2-3 | J1, J2 and J5 Truth Table | 2-14 |
| 2-4 | Remote Control Connections (J3) | 2-19 |


## ILLUSTRATIONS


| Figure | | Page |
|---|---|---|
| 1-1 | Universal Tone Generator, Model TG-1 | 1-0 |
| 1-2 | Timing Diagram (f1→f2 Mode Selected) | 1-2 |
| 2-1 | Front Panel Operationg Controls, Indicators and Connectors | 2-2 |
| 2-2 | Rear Panel Operating Controls and Connectors | 2-6 |
| 2-3 | Secode Output Waveform | 2-10 |
| 2-4 | Set-up for Secode Output | 2-11 |
| 2-5 | IMTS Output Waveform | 2-11 |
| 2-6 | Set-up for IMTS Output | 2-12 |
| 2-7 | MTS Output Waveform | 2-13 |
| 2-8 | Set-up for MTS Output | 2-14 |
| 2-9 | Cascading Interface Schematic Diagram | 2-17 |
| 3-1 | Frequency Synthesis, Block Diagram | 3-3 |
| 4-1 | Correct Triangular Output Waveform | 4-3 |
| 4-2 | Incorrect Output Waveform | 4-3 |
| 5-1 | Universal Tone Generator Functional Diagram | 5-3 |
| A-1 | Modifying Model TG-1B for IMTS, MTS and Secode Output | A-3 |

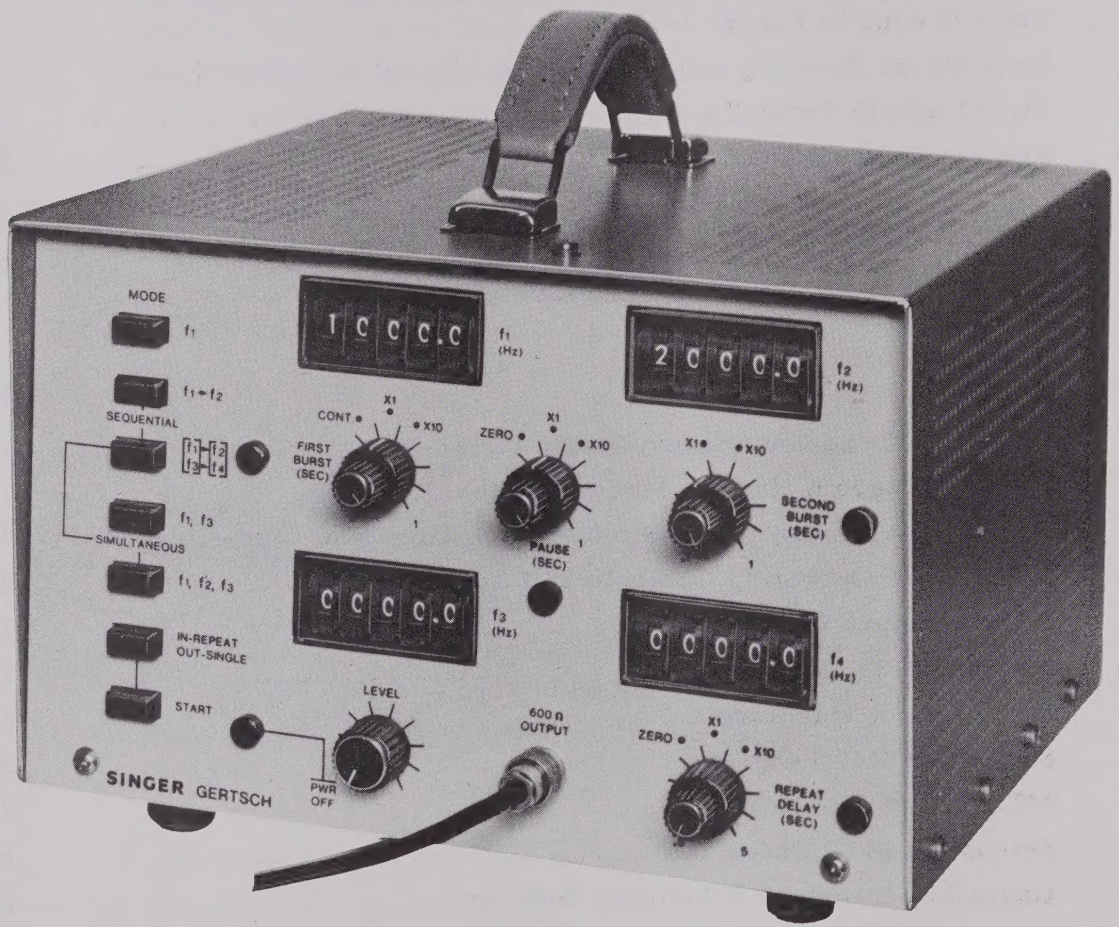



Figure 1-1. Universal Tone Generator, Model TG-1

Section I

# INTRODUCTION

## 1.1 GENERAL

The Universal Tone Generator, Model TG-1, is an accessory for use with any signal generator capable of FM or AM modulation. It equips the generator to service tone-selective communications equipment such as paging units and paging receivers with selective tone code circuitry and decoders.

## 1.2 TONE FORMATS

The TG-1 generates frequencies from 0.1 Hz to 9999.9 Hz in all varieties of tone formats required for tone-selective testing. The various tone formats available are shown in Table 1-1. A typical timing diagram is illustrated in Figure 1-2 showing the tone relationships between two sequential tone bursts. Timing controls are provided for controlling the duration of each tone burst, the pause between bursts and the delay between repeated cycles. All tones in the TG-1 are derived from a crystal oscillator with an accuracy of ±50 ppm. Output level can be varied from zero to 3V peak to peak. Provision is made for individual adjustment of tone levels.

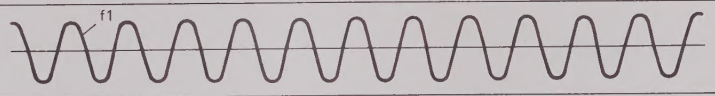
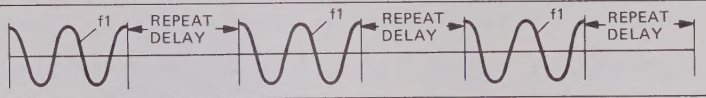
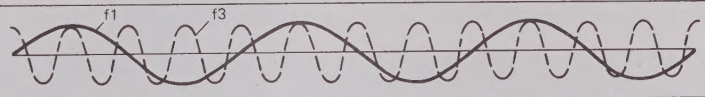
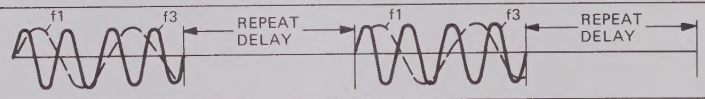
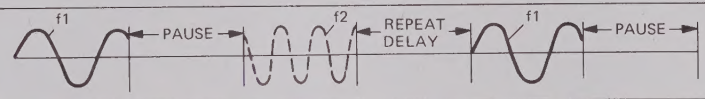
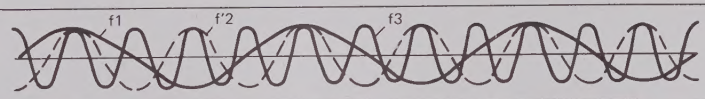
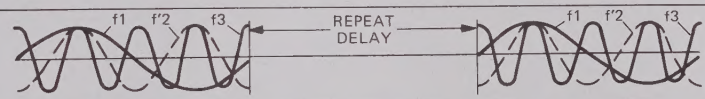
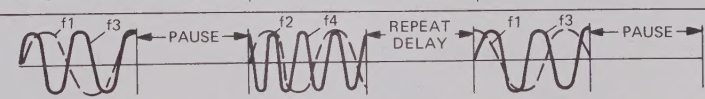
## 1.3 MODELS AVAILABLE

Six variations of the TG-1 are available:

TG-1A
TG-1B
TG-1C
TG-1AP } PROGRAMMABLE
TG-1BP }
TG-1CP }

The most complete unit is Model TG-1CP. It has all the functions described in this manual, including remote programming capability. Three frequency synthesizer boards (A1, A2 and A3) are included.

Table 1-1. Tone Formats

| MODE SWITCH SELECTED | NO. TONES | TIME FORMAT | PICTORIAL REPRESENTATION |
|---|---|---|---|
| f1 | 1 | CONTINUOUS |   |
| f1 | 1 | BURSTS |   |
| f1, f3 | 2 | CONTINUOUS/ SIMULTANEOUS |   |
| f1, f3 | 2 | BURSTS/ SIMULTANEOUS |   |
| f1 → f2 | 2 | SEQUENTIAL BURSTS |   |
| f1, f'2, f3 | 3 | CONTINUOUS/ SIMULTANEOUS |   |
| f1, f'2, f3 | 3 | BURSTS/ SIMULTANEOUS |   |
| [f1 → f2] [f3 → f4] | 4 | SEQUENTIAL BURSTS |   |

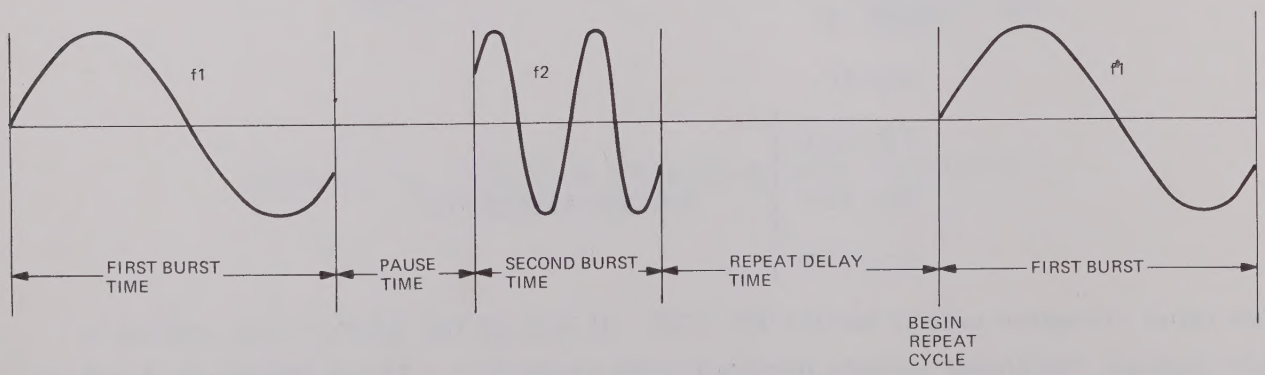



Figure 1-2. Timing Diagram (f1 → f2 Mode Selected)

TG-1A

This model is not capable of supplying two or three tones simultaneously. However it will supply two sequential tone bursts of different frequencies (f1 → f2). It will also supply a single tone continuously or in single tone bursts. The TG-1A contains only one frequency synthesizer board (A3) and two thumbwheels (f3 and f4 are omitted). Integrated circuits AR1 to AR5 are also omitted from assembly A4.

TG-1B

This model will perform all the functions of the TG-1C except three tones simultaneous (f1, f'2, f3).

TG-1C

This is the basic model with all functions except programmability.

TG-1AP

Same as TG-1A with remote programmability.

TG-1BP

Same as TG-1B with remote programmability.

TG-1CP

Same as TG-1C with remote programmability.

## 1.4 APPLICATIONS

The TG-1 can be used to test a wide variety of tone-selective systems.

EXAMPLES:

Private Line** (continuous tone on RF carrier)
Tone Alert (1 tone burst)
Bellboy* (3 tone simultaneous)
Quik-Call** (2 → 2 sequential)
Sel-Call** (2 → 2 sequential)
Secode*** (2805 Hz interrupted)
and others

* Bell System trademark
** Motorola trademark
*** Secode Electronics trademark

Table 1-2. Specifications

| Parameter | Characteristic |
|---|---|
| Frequency range: | 0.1 Hz to 9999.9 Hz<br>(Low frequency 3 dB point less than 20 Hz with 600 ohm load) |
| Accuracy: | ±50 ppm, crystal controlled |
| Resolution: | 0.1 Hz |
| Output: | Sinusoidal; impedance: 600 ohms nominal. Output amplitude for single frequency variable from 0 to 3V p-p ±10% continuous (no-load). Distortion 5% max. Typically 2.5% at 25°C. |
| Modes available: | One-tone continuous (1)<br>One-tone burst (1)<br>Two-tone continuous (2) (TG-1B, TG-1C)<br>Two-tone burst sequential (1→1)<br>Four-tone burst sequential (2→2) (TG-1B, TG-1C)<br>Three-tone simultaneous (3) (TG-1C) |
| Timing ranges: | |
| First burst: | Continuous, 0.1 to 1 sec., 1 to 10 sec. |
| Pause: | Zero, 0.1 to 1 sec., 1 to 10 sec. |
| Second burst: | 0.1 to 1 sec., 1 to 10 sec. |
| Repeat delay: | Zero, 0.5 to 5 sec., 5 to 50 sec. |
| Power requirements: | 115/230V ac, 50 to 400 Hz 12-16V dc, 3A (max) |
| Temperature: | -5°C to +50°C |
| Size: | 10" W × 7" H × 12" D (approx) |
| Weight: | 12 pounds (approx) |
| Fuses: | ac and dc |
| Options: | Remote frequency programming BCD (8, 4, 2, 1) |
| Accessories (Supplied): | 12 Foot dc power cable<br>Instruction Manual |

Section II

# OPERATING INSTRUCTIONS

## 2.1 INTRODUCTION

Check the instrument mechanically for signs of damage, loss of hardware such as knobs, etc.

Check the instrument electrically by performing the performance check procedure presented in Section IV.

To prepare for use, simply plug into an ac source and turn on power switch. For dc source use J4 connector on the rear panel.

Operation of the Universal Tone Generator, Model TG-1 is extremely simple. It may be operated entirely from the front panel controls and requires no calibration before use.

The Instrument has numerous operating modes which enables it to be used for testing most proprietary tone-selective systems such as: Bellboy (Bell System trademark), Quik-Call/Sel-Call/Private Line (Motorola trademarks), Secode (Secode Electronics trademark), Tone Alert, etc.

Front and rear panel operating controls, indicators and connectors are described fully in Tables 2-1 and 2-2.

## 2.2 MODES OF OPERATION

There are three basic modes of operation: continuous, single burst and sequential bursts. Each of these modes may include more than one tone. The complete matrix of modes is displayed in Table 1-1.

## 2.3 TURN-ON TRANSIENTS

The TG-1 may emit an undesired signal for a one cycle period when the power is first applied. The existence of an undesired output is indicated when more than one of the four indicator lights are lit simultaneously.

This condition will last for the total time settings of the four time controls and will clear automatically. To prevent this spurious first cycle from reaching the

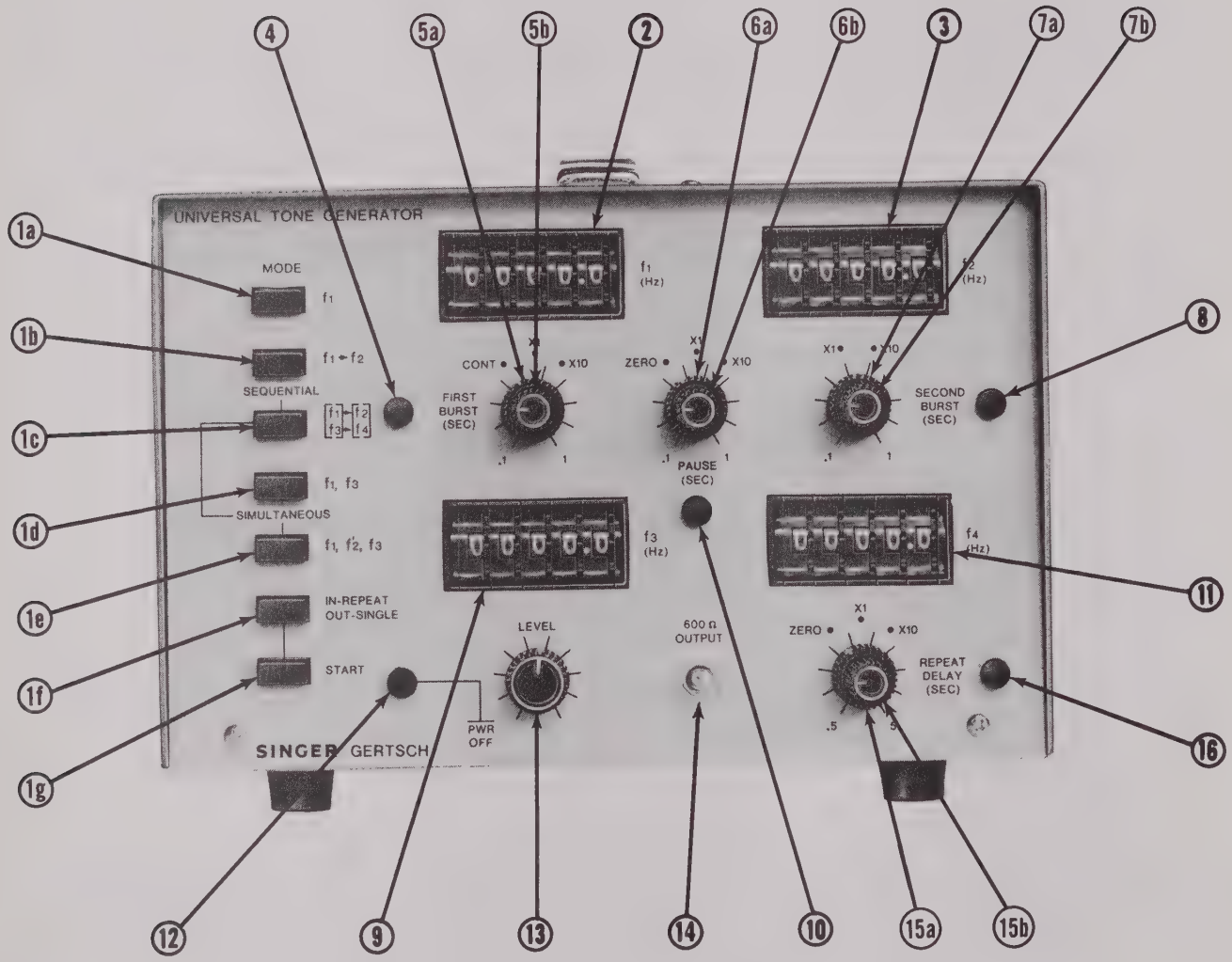



Figure 2-1. Front Panel Operating Controls, Indicators and Connectors

Table 2-1. Front Panel Operating Controls, Indicators and Connectors, TG-1 (Keyed to Figure 2-1)

| ITEM | PANEL MARKING | DESCRIPTION | FUNCTION |
|---|---|---|---|
| 1 | MODE | | |
| 1a | f1 | Switch, push-push | Only f1 appears at the output when this mode is selected. Duration is controlled by FIRST BURST control (Item 5). |
| 1b | f1 → f2 (SEQUENTIAL) | Switch, push-push | In this mode, f1 appears at the output for a duration controlled by FIRST BURST control (Item 5) followed by a pause controlled in duration by PAUSE control (Item 6) followed in turn by f2 controlled in duration by SECOND BURST control (Item 7). NOTE: if FIRST BURST control is at CONTinuous, f1 will appear continuously. |
| 1c | [f1] → [f2]<br>[f3] → [f4]<br>(SEQUENTIAL) | Switch, push-push | In this mode, f1 and f3 appear at output simultaneously both for the same burst duration controlled by FIRST BURST control. They are followed by a pause followed by f2 and f4 simultaneously for a duration controlled by SECOND BURST control. |
| 1d | f1, f3 (SIMULTANEOUS) | Switch, push-push | In this mode, f1 and f3 appear at output simultaneously. Duration is controlled by FIRST BURST control. |
| 1e | f1, f'2, f3<br>(SIMULTANEOUS) | Switch, push-push | In this mode f1, f'2 and f3 appear at output simultaneously. Duration is controlled by FIRST BURST control. |
| 1f | IN-REPEAT<br>OUT-SINGLE | Switch, push-push | At IN position, the selected tone mode will repeat continuously with a repeat delay controlled by REPEAT DELAY (Item 15). At OUT position, the tone mode selected will not repeat. To obtain another tone cycle, the START switch (Item 1g) must be pressed. |
| 1g | START | Switch, push-push | This switch initiates the tone cycling operation of the instrument in both SINGLE and REPEAT modes. |
| 2 | f1 (Hz) | Switch, thumbwheel | Selects frequency, f1, from 0.1 Hz to 9999.9 Hz. |
| 3 | f2 (Hz) | Switch, thumbwheel | Selects frequency, f2. |
| 4 | | Light, indicator | Indicates when FIRST BURST appears at output, for duration of burst. |
| 5a | FIRST BURST (SEC)<br>CONT<br>X1<br>X10 | Switch, rotary, 3 position | In CONT position, first burst is continuous. In X1 position, calibration is in seconds as marked.<br>In X10 position, scale markings multiplied by 10. |
| 5b | .1<br>1 | Potentiometer | Controls tone burst duration from 0.1 to 1 sec or from 1 to 10 secs. |

Table 2-1. Front Panel Operating Controls, Indicators and Connectors, TG-1 (Keyed to Figure 2-1) - Continued

| ITEM | PANEL MARKING | DESCRIPTION | FUNCTION |
|---|---|---|---|
| 6a | PAUSE (SEC)<br>ZERO<br>X1<br>X10 | Switch, rotary, 3 position | In ZERO position, pause is zero. In X1 position, calibration is in seconds In X10 position, calibration is multiplied by 10. |
| 6b | .1<br>1 | Potentiometer | Controls pause from 0.1 to 1 sec or from 1 to 10 secs. |
| 7a | SECOND BURST (SEC)<br>X1<br>X10 | Switch, rotary, 2 position | In X1 position, calibration is in seconds as marked. |
| | | | In X10 position, scale markings multiplied by 10. |
| 7b | .1<br>1 | Potentiometer | Controls tone burst duration from 0.1 sec to 1 sec or from 1 sec to 10 secs. |
| 8 | | Indicator Light | Indicates when SECOND BURST appears at output, for duration of burst. |
| 9 | f3 (Hz) | Switch, thumbwheel | Selects frequency f3. |
| 10 | | Light, indicator | Indicates pause duration between sequential bursts. |
| 11 | f4 (Hz) | Switch, thumbwheel | Selects frequency f4. |
| 12 | PWR OFF | Light, indicator | Indicates power "ON" condition. |
| 13 | LEVEL | Potentiometer | Controls output level. |
| 14 | 600 OHM OUTPUT | Connector, BNC | Output connector. |
| 15a | REPEAT DELAY (SEC)<br>ZERO<br>X1<br>X10 | Switch, rotary, 3 position | In ZERO position, delay is zero. In X1 position, delay is 0.5 to 5 secs. In X10 position, delay is 5 to 50 secs. |
| 15b | .5<br>5 | Potentiometer | Controls repeat delay duration from 0.5 to 5 sec or from 5 to 50 secs. |
| 16 | | Light, indicator | Indicates repeat delay duration. |

Table 2-2. Rear Panel Controls and Connections
(Keyed to Figure 2-2)

| ITEM | PANEL MARKING | DESCRIPTION | FUNCTION |
|---|---|---|---|
| 1 | AC-DC | Switch, slide | Selects ac or dc operation. |
| 2 | 115/230V | Switch, slide | Selects 115V or 230V operation. |
| 3 | REMOTE PROGRAMMING | Connector, 100 pin | Accepts inputs for remote programming. |
| 4 | 12V DC | Connector, 4 pin | 12V dc input connector. |
| 5 | F1 | Fuse 3/4A slo-blo<br>Fuse 3/8A slo-blo | Protects ac input circuit (115V)<br>Protects ac input circuit (230V) |
| 6 | F2 | Fuse 3A slo-blo | Protects dc input circuit |
| 7 | J1 | Connector, phonejack | Remote telephone dial input ] for Secode and IMTS output |
| 8 | J2 | Connector, phonejack | Remote telephone dial input ] for Secode and IMTS output |
| 9 | J5 | Connector, phonejack | Remote telephone dial input [ for MTS output ] |
| 10 | f1 | Potentiometer | Adjusts output level of f1 |
| 11 | f2 | Potentiometer | Adjusts output level of f2 |
| 12 | f'2 | Potentiometer | Adjusts output level of f'2 |
| 13 | f3 | Potentiometer | Adjusts output level of f3 |
| 14 | f4 | Potentiometer | Adjusts output level of f4 |

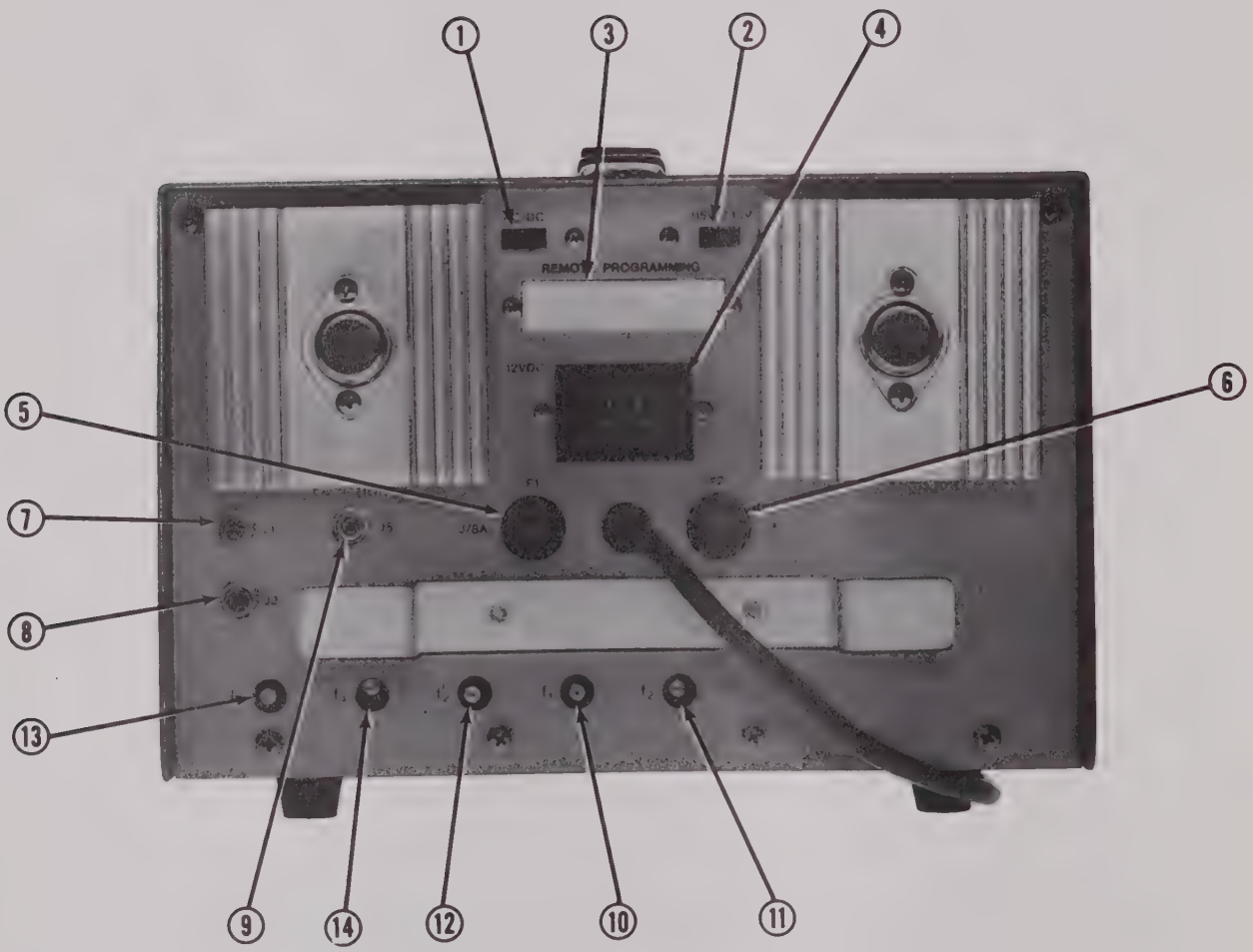



Figure 2-2. Rear Panel Operating Controls and Connectors

external test circuitry, maintain the LEVEL control at maximum ccw position (at which the output level is zero) until all lights are out (except the power light). Since the spurious condition will last for the total time set on the four time controls, the time needed to eliminate the spurious condition may be shortened to 0.2 seconds by setting all four time controls to minimum.

## 2.4 OPERATING PROCEDURES

### 2.4.1 Continuous - Single Tone

a. Set controls as follows:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE f1 | In |
| f1 (thumbwheel) | Desired frequency |
| FIRST BURST | CONT. |

b. Connect 600Ω OUTPUT connector to external test circuit.

c. When all indicator lights are out (refer to paragraph 2-3), adjust LEVEL control for desired output level. Maxium cw position is approximately 0.5 Vrms with a 600 ohm load.

### 2.4.2 Continuous Two-Tone Simultaneous

Repeat paragraph 2.4.1 except set MODE switch f1, f3 to IN position.

### 2.4.3 Continuous Three-Tone Simultaneous

Repeat paragraph 2.4.1 except set MODE switch f1, f'2, f3 to IN position.

### 2.4.4 Single Burst - Single Tone

a. Set controls:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE f1 | In |
| f1 (thumbwheel) | Desired frequency |
| FIRST BURST | Desired duration |

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. When all indcator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch. Note, all indicator lights must be out before starting.

2.4.5 Single Burst - Two Tone Simultaneous

a. Set Controls:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE f1, f3 | In |
| f1 (thumbwheel) | Desired frequency |
| f3 (thumbwheel) | Desired frequency |
| FIRST BURST | Desired duration |

b. Connect 600 Ω OUTPUT connector to external circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

2.4.6 Single Burst - Three-Tone Simultaneous

a. Set controls:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE f1, f'2, f3 | In |
| f1 (thumbwheel) | Desired frequency |
| f2 (thumbwheel) | Desired frequency |
| f3 (thumbwheel) | Desired frequency |
| FIRST BURST | Desired duration |

b. Connect OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

2.4.7 Sequential Bursts, f1 → f2

a. Set controls:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE f1 → f2 | In |
| f1 (thumbwheel) | Desired frequency |
| f2 (thumbwheel) | Desired frequency |
| FIRST BURST | Desired duration |
| PAUSE | Desired duration |
| SECOND BURST | Desired duration |

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone bursts is required, set REPEAT DELAY to desired duration and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

2.4.8 Sequential Bursts [f1, f3] → [f2, f4]

a. Set controls:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE [f1, f3] → [f2, f4] | In |
| f1 (thumbwheel) | Desired frequency |
| f2 (thumbwheel) | Desired frequency |
| f3 (thumbwheel) | Desired frequency |
| f4 (thumbwheel) | Desired frequency |
| FIRST BURST | Desired duration |
| PAUSE | Desired duration |
| SECOND BURST | Desired duration |

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

## 2.5 SECODE TESTING (REF. TO APPENDIX A FOR UPGRADING TG-1B FOR IMTS, MTS AND SECODE.)

The TG-1C and TG-1CP supply a Secode tone output waveform when an external telephone dial is connected to the rear panel connectors J1 and J2. The output waveform is shown in Figure 2-3.

The set-up procedure is as follows:

a. Set controls:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE f1 | In |
| f2 (thumbwheel) | Desired frequency |

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. Connect telephone dial to J1 and J2 input connectors on rear panel as shown in Figure 2-4.

d. When all indicator lights are out, adjust LEVEL control for desired output level.

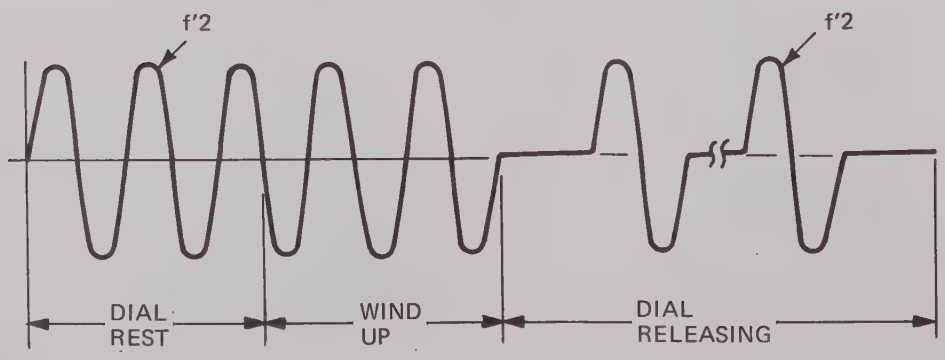



Figure 2-3. Secode Output Waveform

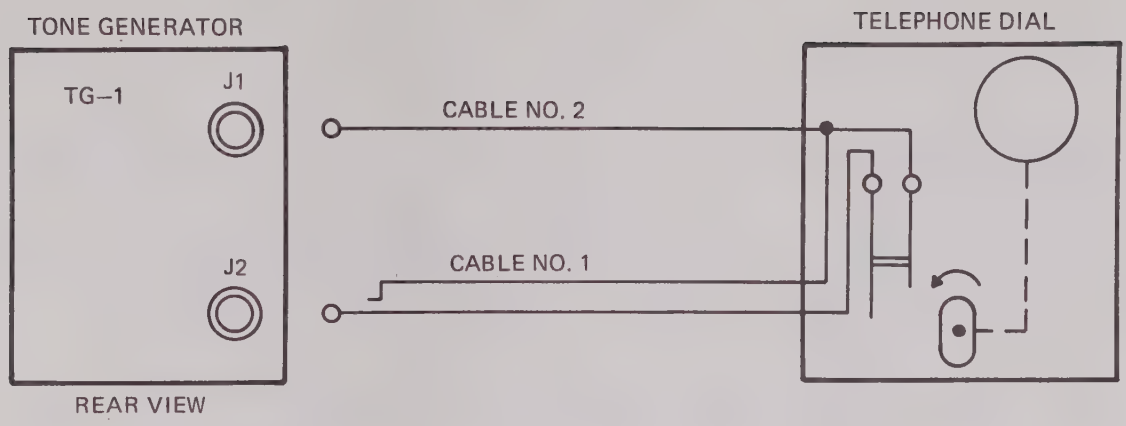



Figure 2-4. Set-up for Secode Output

## 2.6 IMTS TESTING (REF. TO APPENDIX A FOR UPGRADING TG-1B FOR IMTS, MTS AND SECODE.)

Models TG-1C and TG-1CP can supply an IMTS output waveform when an external telephone dial is connected to rear panel connectors J1 and J2. The output waveform is shown in Figure 2-5.

The set-up procedure is as follows:

a. Set controls:

| | |
|---|---|
| Power (LEVEL Control) | On/Max ccw |
| MODE f1 | In |
| FIRST BURST | CONT. |
| f1 (thumbwheel) | Desired frequency |
| f2 (thumbwheel) | Desired frequency |

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. Connect telephone dial to J1 and J2 connectors on rear panel as shown in Figure 2-6.

d. When all indicator lights are out, adjust LEVEL control for desired output level.

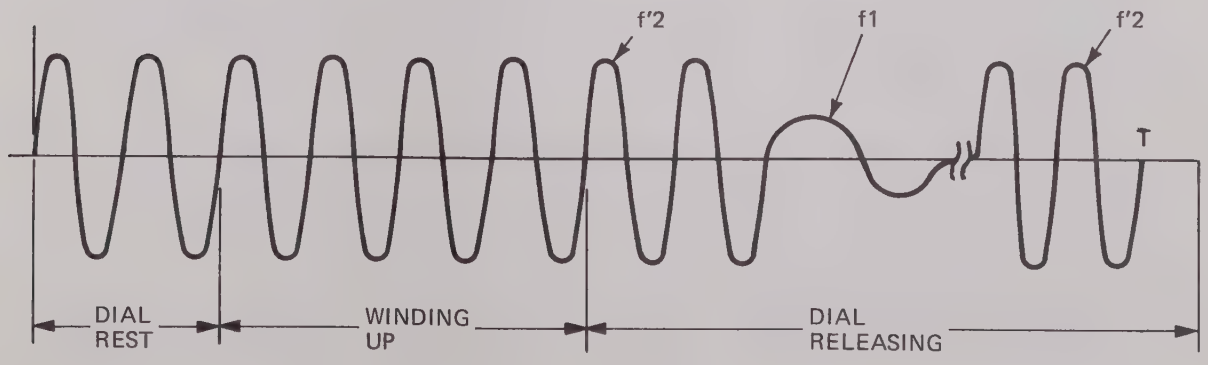



Figure 2-5. IMTS Output Waveform

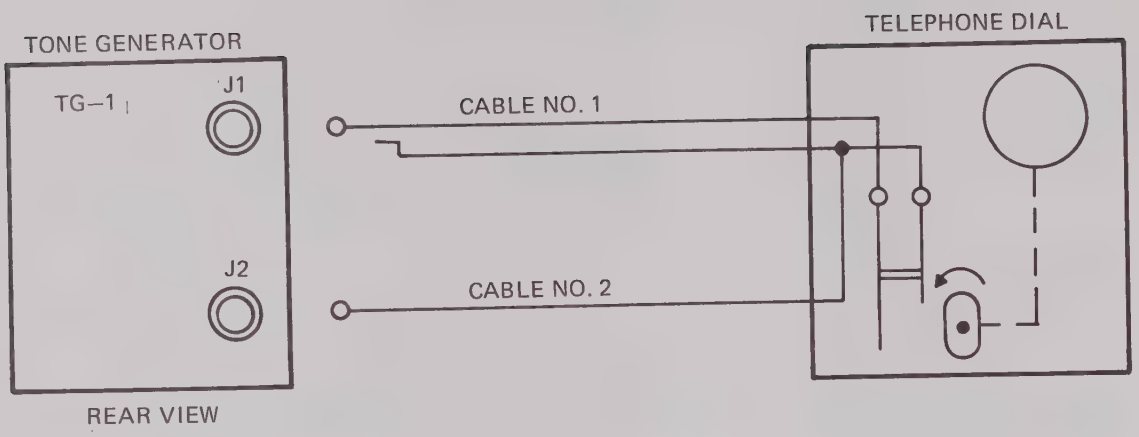



Figure 2-6. Set-up for IMTS Output

## 2.7 MTS TESTING (REF. TO APPENDIX A FOR UPGRADING TG-1B FOR IMTS, MTS AND SECODE.)

Models TG-1C and TG-1CP supply an MTS output waveform when an external telephone dial is connected to rear panel connectors J5 and J2. The output waveform is shown in Figure 2-7.

The procedure is as follows:

a. Set controls:

| | |
|---|---|
| Power (LEVEL control) | On/Max ccw |
| MODE f1 | In |
| f1 (thumbwheel) | Desired frequency |
| f2 (thumbwheel) | Desired frequency |

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. Connect telephone dial to J5 and J2 connectors on rear panel as shown in Figure 2-8.

d. When all indicator lights are out, adjust LEVEL control for desired output level.

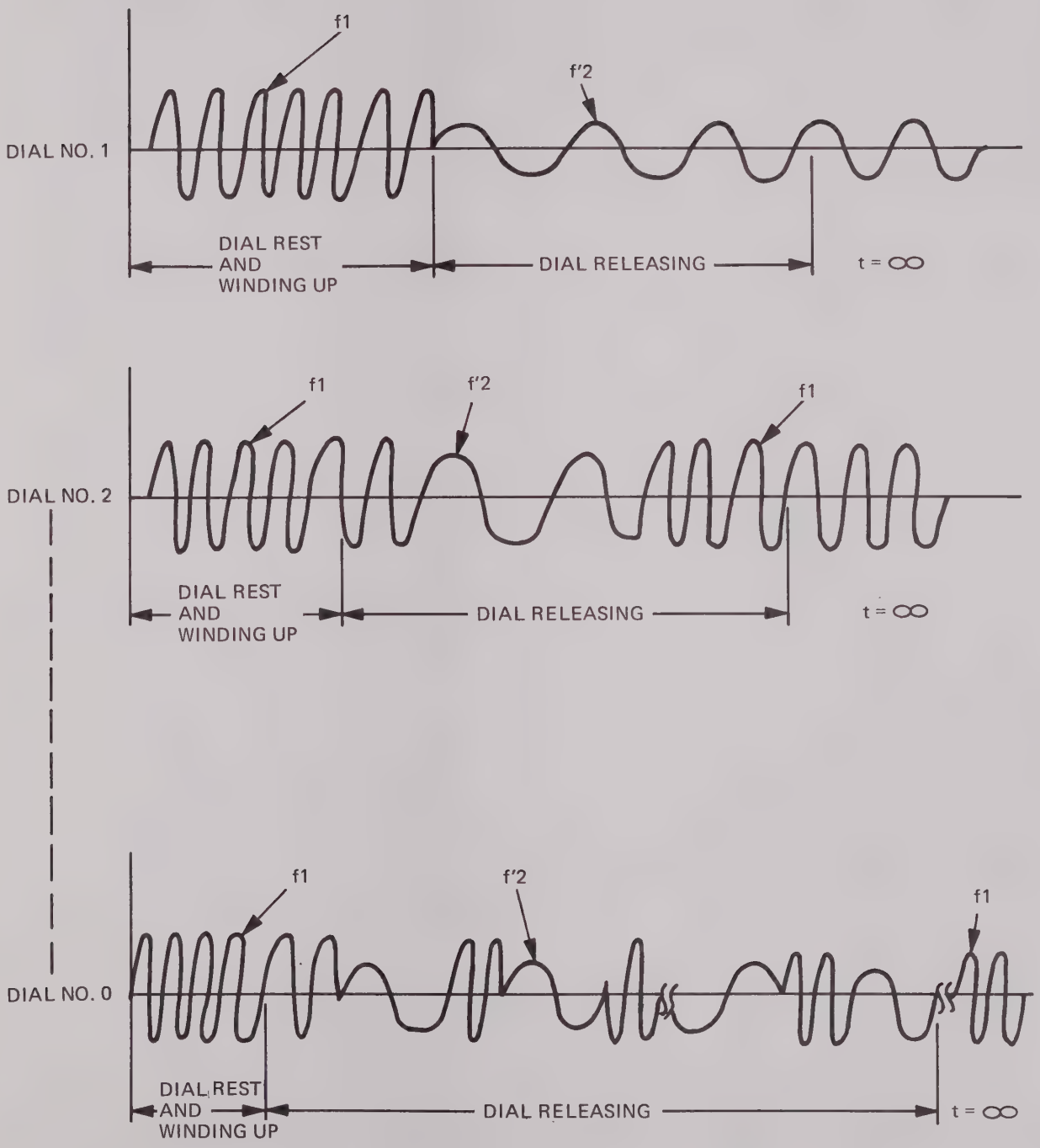



Figure 2-7. MST Output Waveform

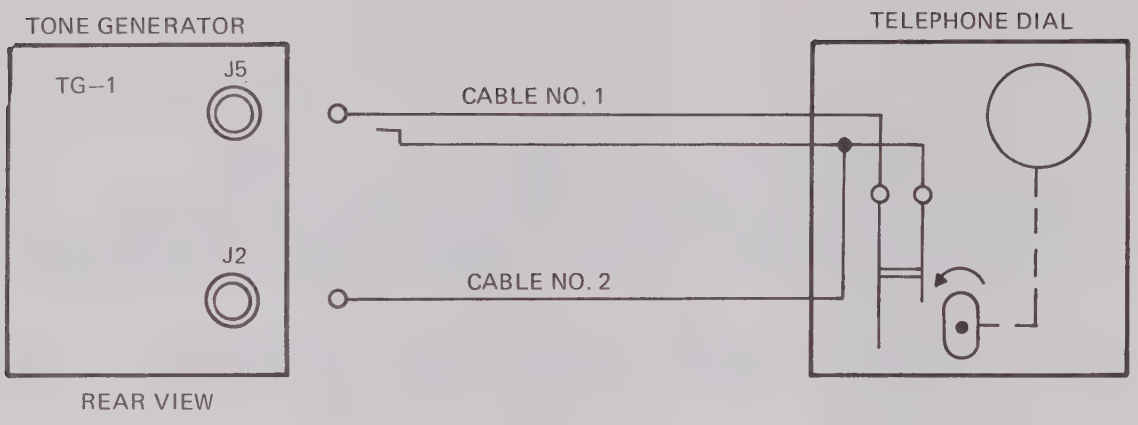



Figure 2-8. Set-up for MTS Output
Refer to Table 2-3 for J1, J2 and J5 Truth Table

Table 2-3. J1, J2 and J5 Truth Table

| | J1 | J2 | J5 | OUTPUT |
|---|---|---|---|---|
| STATIC | OPEN | OPEN | OPEN | f1 |
| | CLOSED | OPEN | OPEN | 0 |
| | OPEN | CLOSED | OPEN | f1 |
| | CLOSED | CLOSED | OPEN | f'2 |
| DYNAMIC | OPEN ↕ OPEN | CLOSED ↕ CLOSED | NORMALLY CLOSED (INTERRUPTED BY DIAL) | DIAL #1 f1 → f'2<br>#2 f1 → f'2 → f1<br>#3 f1 → f'2 → f1 → f'2<br>#4 f1 → f'2 → f1 → f'2 → f1<br>#5 f1 → f'2 → f1 → f'2 → f1 → f'2<br>#6 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1<br>#7 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2<br>#8 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1<br>#9 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2<br>#0 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 |

## 2.8 INDEPENDENT TONE LEVEL ADJUSTMENTS

The TG-1 has the capability for independent adjustment of all four tone output levels by means of potentiometers on the rear panel. The instrument is supplied with all tones set to maximum level (1.1 Vrms). However, the gain of each tone circuit may be reduced independently for specific applications. The output levels of all four tones are also controlled simultaneously by the front panel LEVEL control. See Specifications Table 1-2 for electrical output specifications.

Note that there are two potentiometers on the rear panel for adjusting f2, one labeled f2, and the other labeled f'2. The f'2 pot is used to set the level of f2 when the f1, f'2, f3 simultaneous mode is selected.

### 2.8.1 Preliminary Procedure

a. Connect oscilloscope to OUTPUT connector.

b. Set front panel LEVEL control to max cw and maintain it in this position while making the following independent tone level adjustments.

### 2.8.2 Frequency f1 Level Adjustment

a. Set controls:

| | |
|---|---|
| MODE f1 | In |
| FIRST BURST | CONT. |
| f1 (thumbwheel) | Desired frequency |

b. Obtain display of frequency, f1, on oscilloscope.

c. Adjust potentiometer, f1, on rear panel until desired level is obtained.

### 2.8.3 Frequency f2 Level Adjustment

a. Set controls:

| | |
|---|---|
| MODE f1 → f2 | In |
| FIRST BURST switch | X1 |
| FIRST BURST potentiometer | Max ccw |
| PAUSE | ZERO |
| REPEAT DELAY | ZERO |
| f1 (thumbwheel) | 0000.0 Hz |
| f2 (thumbwheel) | Desired frequency |
| f3 (thumbwheel) | 0000.0 Hz |
| f4 (thumbwheel) | 0000.0 Hz |

| | |
|---|---|
| SECOND BURST switch | X10 |
| SECOND BURST potentiometer | Max cw |
| IN-REPEAT/OUT-SINGLE | IN-REPEAT |

b. Push START switch

c. Obtain display of frequency, f2, on oscilloscope.

d. Adjust potentiometer, f2, on rear panel until desired level is obtained.

2.8.4 Frequency f3 Level Adjustment

a. Set controls:

| | |
|---|---|
| MODE f1, f3 | In |
| FIRST BURST | CONT. |
| f1 (thumbwheel) | 0000.0 Hz. |
| f2 (thumbwheel) | 0000.0 Hz |
| f3 (thumbwheel) | Desired frequency |
| f4 (thumbwheel) | 0000.0 Hz |

b. Obtain display of frequency, f3, on oscilloscope.

c. Adjust potentiometer, f3, on rear panel until desired level is obtained.

2.8.5 Frequency f4 Level Adjustment

a. Set controls:

| | |
|---|---|
| MODE [f1, f3]→[f2, f4] | In |
| FIRST BURST switch | X1 |
| FIRST BURST potentiometer | Max ccw |
| PAUSE | ZERO |
| REPEAT DELAY | ZERO |
| SECOND BURST switch | X10 |
| SECOND BURST potentiometer | Max cw |
| f1 (thumbwheel) | 0000.0 Hz |
| f2 (thumbwheel) | 0000.0 Hz |
| f3 (thumbwheel) | 0000.0 Hz |
| f4 (thumbwheel) | Desired frequency |
| IN-REPEAT/OUT-SINGLE | In |

b. Push START switch

c. Obtain display of frequency, f4, on oscilloscope.

d. Adjust potentiometer, f4, on rear panel until desired level is obtained.

### 2.8.6 Frequency f'2 Level Adjustment

a. Set controls:

| | |
|---|---|
| MODE f1, f'2, f3 | In |
| FIRST BURST | CONT. |
| f1 (thumbwheel) | 0000.0 Hz |
| f2 (thumbwheel) | Desired frequency |
| f3 (thumbwheel) | 0000.0 Hz |
| f4 (thumbwheel) | 0000.0 Hz |

b. Obtain display of frequency, f2, (same as f'2) on oscilloscope.

c. Adjust potentiometer, f'2, on rear panel until desired level is obtained.

## 2.9 REMOTE CONTROL

Models TG-1AP, TG-1BP, and TG-1CP may be programmed with BCD input for frequency selection, and start and stop may be performed remotely via rear panel connector J3. See Table 2-4 for remote control connector pin functions. Note that all thumbwheels must be at 0000.0 Hz for remote frequency control.

## 2.10 CASCADING

Two TG1's may be connected in cascade to perform 4 sequential bursts, as shown in Figure 2-9. Only programmable units may be cascaded.

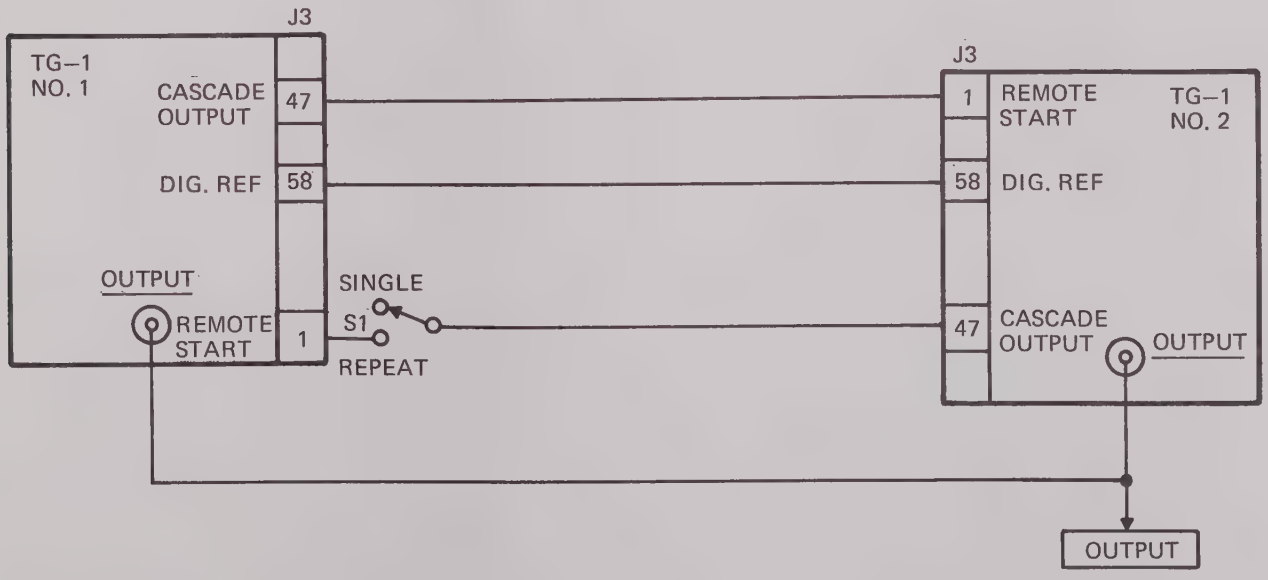



Figure 2-9. Cascading Interface Schematic Diagram

### 2.10.1 Single Cycle

To generate one sequential cycle of four bursts perform the following:

a. Set toggle switch, S1, to "Single" (open) position.

b. Set switch IN-REPEAT/OUT-SINGLE to the OUT-SINGLE position on both TG-1's.

c. Select desired mode and timing on both TG-1's.

d. Connect output as shown in Figure 2-9.

e. Press the pushbutton switch START on the TG-1 No. 1 only. (see paragraph 2.3).

### 2.10.2 Repeat Cycle

To obtain cycling operation perform the following:

a. Set switch IN-REPEAT/OUT-SINGLE to the OUT-SINGLE position on both TG-1's.

b. Select desired mode and timing on both TG-1's.

c. Set toggle switch, S1, to "Single" (open) position.

d. Turn on power on both units (see paragraph 2.3).

e. Set toggle switch, S1, to "Repeat" (closed) position.

f. If TG-1 (No. 1) failed to start press pushbutton switch START on TG-1 No. 1 only.

Table 2-4. Remote Control Connections (J3)

| FUNCTION | PIN NUMBERS |
|---|---|
| Digital Common: | Pins 58 and 59 |
| Remote Start:<br>Starts repeat cycling function.<br>Compatible with $T^2L$ logic.<br>Logic "1" = 4 ±1 Vdc<br>Logic "0" = $0^{-0}_{+.5}$ Vdc | Pin 1 |
| Remote Stop:<br>Stops repeat cycling function.<br>Compatible with $T^2L$ logic.<br>Logic "1" = $0^{-0}_{+.5}$ Vdc<br>Logic "0" = 4 ±1 Vdc<br>Output power Available:<br>+12 Vdc<br>+ 5 Vdc | Pin 44<br><br><br><br><br><br>Pin 50<br>Pin 52 |
| Cascade Output: | Pin 47 |
| Spare Pins: | 41, 45, 46, 48, 49, 51, 53, 54, 55, 56, 57 |

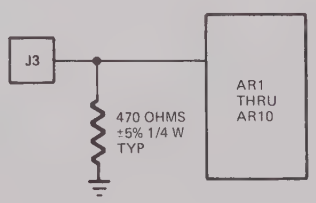
Remote Frequency Programming:

Note: <u>All thumbwheels must be at zero</u>. Interface is not compatible with $T^2L$ logic. Each input has a pull down resistor as shown below:

Input high:

$I_{IH} \simeq 10$ mA

$V_{IH} = +5 \pm 1$ Vdc




Input low: Open or connected to digital common.

Table 2-4. Remote Control Connections (J3)- Continued

| Frequency f1 | | | Frequency f2 | | |
|---|---|---|---|---|---|
| PIN | BCD (BINARY) | | PIN | BCD (BINARY) | |
| 79 | 1 | $10^{+4}$ (MSD)* | 42 | 1 | $10^{+4}$ (MSD) |
| 80 | 2 | | 43 | 2 | |
| 81 | 4 | | 21 | 4 | |
| 82 | 8 | | 22 | 8 | |
| 83 | 1 | $10^{+3}$ | 23 | 1 | $10^{+3}$ |
| 84 | 2 | | 24 | 2 | |
| 85 | 4 | | 25 | 4 | |
| 86 | 8 | | 26 | 8 | |
| 87 | 1 | $10^{+2}$ | 27 | 1 | $10^{+2}$ |
| 88 | 2 | | 28 | 2 | |
| 60 | 4 | | 29 | 4 | |
| 61 | 8 | | 2 | 8 | |
| 62 | 1 | $10^{+1}$ | 3 | 1 | $10^{+1}$ |
| 63 | 2 | | 4 | 2 | |
| 64 | 4 | | 5 | 4 | |
| 65 | 8 | | 6 | 8 | |
| 66 | 1 | $10^{-1}$ (LSD)* | 7 | 1 | $10^{-1}$ (LSD) |
| 67 | 2 | | 8 | 2 | |
| 68 | 4 | | 9 | 4 | |
| 40 | 8 | | 10 | 8 | |

| Frequency f3 | | | Frequency f4 | | |
|---|---|---|---|---|---|
| PIN | BCD (BINARY) | | PIN | BCD (BINARY) | |
| 39 | 1 | $10^{+4}$ (MSD) | 98 | 1 | $10^{+4}$ (MSD) |
| 38 | 2 | | 97 | 2 | |
| 37 | 4 | | 96 | 4 | |
| 36 | 8 | | 95 | 8 | |
| 35 | 1 | $10^{+3}$ | 94 | 1 | $10^{+3}$ |
| 34 | 2 | | 93 | 2 | |
| 33 | 4 | | 92 | 4 | |
| 32 | 8 | | 91 | 8 | |
| 31 | 1 | $10^{+2}$ | 90 | 1 | $10^{+2}$ |
| 30 | 2 | | 89 | 2 | |
| 20 | 4 | | 78 | 4 | |
| 19 | 8 | | 77 | 8 | |
| 18 | 1 | $10^{+1}$ | 76 | 1 | $10^{+1}$ |
| 17 | 2 | | 75 | 2 | |
| 16 | 4 | | 74 | 4 | |
| 15 | 8 | | 73 | 8 | |
| 14 | 1 | $10^{-1}$ (LSD) | 72 | 1 | $10^{-1}$ (LSD) |
| 13 | 2 | | 71 | 2 | |
| 12 | 4 | | 70 | 4 | |
| 11 | 8 | | 69 | 8 | |

*MSD = most significant digit
LSD = least significant digit

Section III

# THEORY OF OPERATION

## 3.1 GENERAL

The circuitry of the Tone Generator Model TG-1 falls into two major categories: (1) frequency synthesis circuits and (2) the control logic circuits. The theory of operation for these two groups of circuits provides a comprehensive explanation of the instrument.

## 3.2 FREQUENCY SYNTHESIS CIRCUITS (Refer to Figure 3-1)

The TG-1 has three identical frequency synthesis boards: A1, A2 and A3. Each board synthesizes a tone by means of a digital counting process and each board has two inputs. One input is the system clock (fo) which is the basic signal source for the derivation of the output tone. It provides an input frequency of 1.98 MHz. The other input is a set of binary coded decimal (BCD) lines (8, 4, 2, 1). These lines determine the output frequency of the synthesizer board and hence of the output tone. The output frequency is given by the equation:

$$f_{output} = Mfo$$

where:

f output = output frequency

M = BCD scale factor

fo = 1.98 MHz

These two inputs control the decade rate scalers (DRS) consisting of AR1 - AR5 on each of the three frequency synthesizer boards A1, A2 and A3. The output from the DRS is applied to a serial-input, digital-to-analog (D/A) converter. This D/A converter consists of an up/down counter (AR7 - AR8) and a BCD ladder network (R4 - R18). The output voltage of the D/A converter represents a staircase signal, each step being proportional to the number of input pulses received from the DRS. When the up/down counter reaches maximum count, the up/down control circuits (AR9/AR10) switch the counter from up to down counting. Wnen the counter reaches zero, the up/down control commands it to reverse itself and count upwards. Thus the output of the D/A converter is a positive staircase triangular waveform.

This positive triangular waveform is applied to negative-biased input amplifier, AR11. The output of this amplifier is a symmetrical triangular function. The triangle waveform is further converted into a sinewave through triangle-to-sine converter Q1.

### 3.2.1 Multiplexing

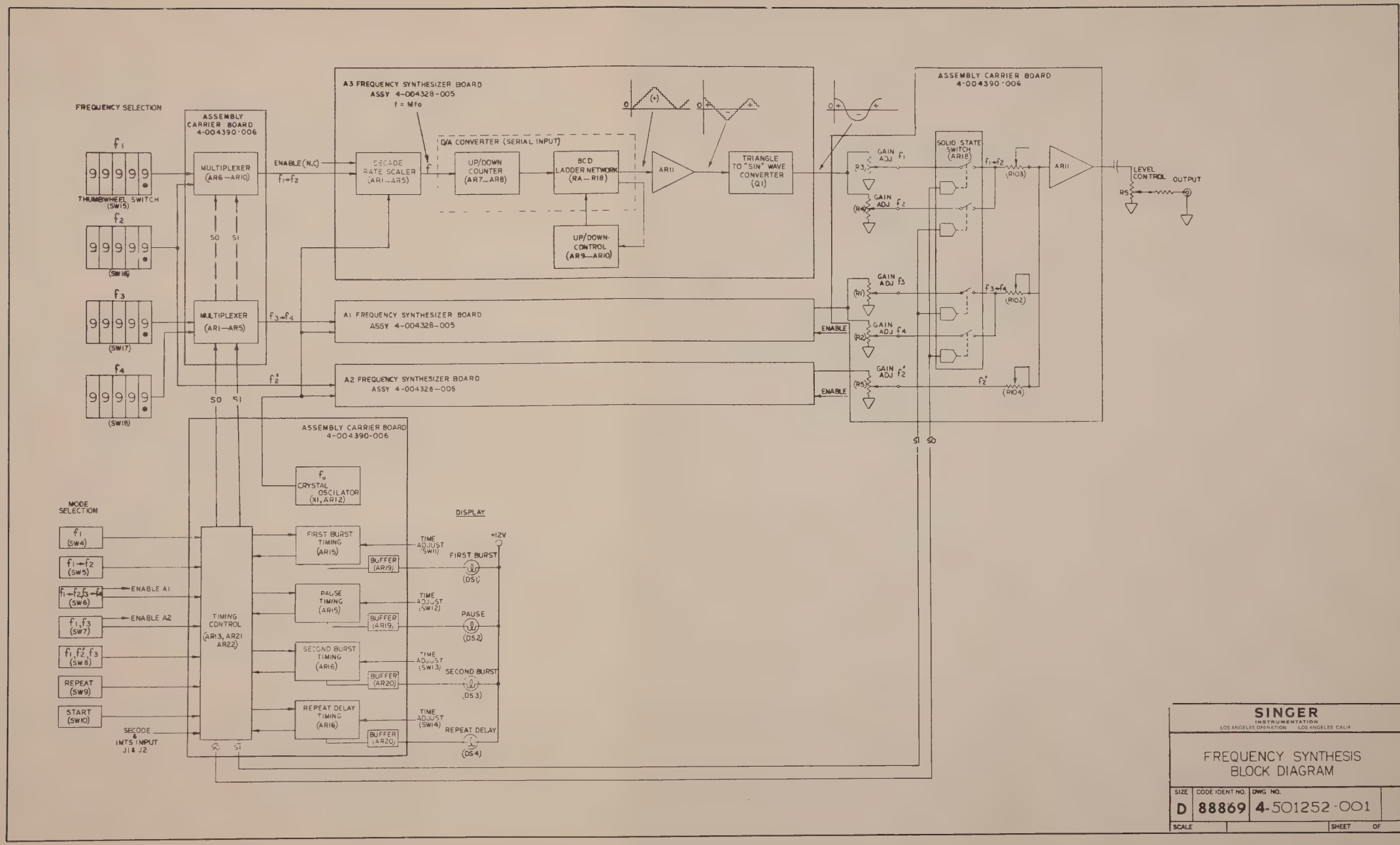
Frequency synthesizer boards A1 and A3 are capable of receiving two frequency selections by means of a multiplexer. A3 frequency synthesizer board can receive f1 or f2 frequency control lines from the thumbwheel switches through multiplexer AR6 - AR10. A1 frequency synthesizer board can receive f3 or f4 frequency control lines from the thumbwheel switches through multiplexer AR1 - AR5. A2 frequency synthesizer board does not have a multiplexing input. Each frequency board also has one enable input which is used in mode selection. A3 frequency synthesizer board is enabled at all times.

### 3.2.2 Output

The output of each frequency board has a fixed gain determined by amplifier AR11. Provision is made for adjusting the gain of each frequency (f1, f2, f'2, f3 and f4). This can be accomplished by adjusting potentiometers R1 - R5 located on the carrier board, A4, and they are accessible via the rear panel. The signal then is applied to solid state switch, AR18, which is controlled by timing control lines $\overline{S0}$ and $\overline{S1}$. The output of AR18 is connected to the input of A4AR11. When $\overline{S0}$ and $\overline{S1}$ control lines select frequency, f1, to go through the multiplexer and control A3 frequency synthesizer board, at the same time control lines $\overline{S0}$ and $\overline{S1}$ will turn on the gate connected to potentiometer, R3. The second gate connected to potentiometer, R4, will be open. Therefore the position of R3 will determine the output of amplifier A4AR11. If f2 frequency is selected, the second gate will be closed and the first open. Potentiometer, R4, will then determine the output of the amplifier. In other words, the solid state switch serves as a demultiplexer to allow a different gain for each selected frequency.

The output of A2 frequency synthesizer board (f'2) may be adjusted with potentiometer A4R5. Potentiometers R102, R103 and R104 are adjusted for calibration purposes only.

Overall level control is adjusted by front panel potentiometer LEVEL control (R5).




SINGER
INSTRUMENTATION
LOS ANGELES OPERATION LOS ANGELES CALIF

FREQUENCY SYNTHESIS
BLOCK DIAGRAM

| SIZE | CODE IDENT NO. | DWG NO. |
|---|---|---|
| D | 88869 | 4-501252-001 |

SCALE SHEET OF

Figure 3-1. Frequency Synthesis, Block Diagram

## 3.3 CONTROL LOGIC CIRCUITS

Control logic circuits are used to perform the following functions:

a. To generate timing for bursts, pause, and repeat delay. (Multiplexing through lines S0 and S1 and demultiplexing through lines $\overline{S0}$ and $\overline{S1}$).

b. To select mode of operation.

c. To determine single or repeat operation.

d. To perform the start function.

e. To provide buffering for indicator lights.

### 3.3.1 Timing Circuits

Each of the functions; first burst, pause, second burst, and repeat delay has a separate timing circuit (on integrated circuits AR15 and AR16). Time durations are controlled by front panel controls SW11, SW12, SW13, and SW14. All four timing circuits are connected sequentially. Each one activates the following delay circuit at the completion of its own timing cycle. Some timing may be by-passed, depending on the mode selected. The timing circuits also drive the indicator lights through buffers AR19 and AR20.

### 3.3.2 Modes of Operation

The mode-selection push-button switches and timing circuits are interconnected in such a way as to perform the desired functions. For example: If mode f1, f'2, f3 is selected, the circuit enables A1, A2, and A3 frequency synthesizer boards and allows the first burst to be generated (f1, f'2, f3). The second burst circuit is by-passed and therefore disabled.

### 3.3.3 Repeat Cycling Circuits

The control logic cycling circuit determines when the first burst should be initiated again in the automatic repeat mode. The trailing edge of the repeat delay pulse from timing circuit AR16 initiates the first burst in the repeat mode or stops cycling in the single cycle mode. (Time for one cycle = first burst time + pause time + second burst time + repeat delay time).

### 3.3.4 Start Circuit

This circuit (AR22) initiates the first burst timing cycle when pushbutton START is pressed. The "Start" function is also available on the rear connector (J3) ($T^2L$ compatible).

### 3.3.5 Stop Circuit

This circuit is part of start/stop circuit (AR21, AR22). To stop cycling in the repeat mode set IN-REPEAT/OUT-SINGLE switch to the OUT-SINGLE position. On programmable units, the stop function is also available on the rear connector (J3).

Section IV

# MAINTENANCE

## 4.1 INTRODUCTION

The Universal Tone Generator Model TG-1 is calibrated at the factory and should be recalibrated every six months. Procedures are given in this section for adjusting the distortion of the frequency synthesizer boards, adjusting the timing circuits, and adjusting the power supply. All three frequency synthesizer boards are identical but will require realignment if they are removed and re-installed in different connectors. They are calibrated at the factory for minimum distortion.

## 4.2 TEST EQUIPMENT

The following instruments are required for calibration and re-alignment:

a. Oscilloscope, Tektronix Model 543B or equivalent with 10X Probe.

b. Resistor decade box, (100-500K).

c. Distortion meter, HP331A, or equivalent.

d. 44 pin extender board Singer (P/N 4-103189-001), or equivalent (optional).

e. Voltmeter, Triplett 630-A or equivalent.

f. Counter, HP 5532A or equivalent.

## 4.3 POWER SUPPLY ADJUSTMENT

Only the +10V dc supply is adjustable. The -10V dc is adjusted automatically by adjustment of the +10V dc supply. Connect the voltmeter to AR17-4 on Carrier Board, A4, and check that the voltage is +10V dc. If it is not +10V dc, adjust potentiometer R10.

## 4.4 TEST AND ADJUSTMENT PROCEDURES FOR FREQUENCY SYNTHESIZER BOARDS

### 4.4.1 Frequency Synthesizer Board, A1

#### 4.4.1.1 Triangularity Check

a. Install extender board (if available) in place of A1 and connect A1 into the extender.

b. Turn on power to the TG-1 and set LEVEL control to max CW.

c. Push MODE switch f1, f3 to IN position.

d. Set FIRST BURST switch to CONT.

e. Connect oscilloscope 10X probe to output of amplifier AR11-10 or R28.

f. Set thumbwheel f3 to 9000.0 Hz.

g. The output should be triangular as shown in Figure 4-1. If the waveform is broken as shown in Figure 4-2, the digital-to-analog converter is not functioning uniformly for all bits, and the following adjustment procedure should be performed.

4.4.1.2 Triangularity Adjustment Procedure. The following procedure is intended to correct the type of break illustrated in Figure 4-2. While other break points are possible, a fault is most likely to appear at the point shown. The numbers shown in Figure 4-2 correspond to the bit weight of the most significant decade. Bit 8 is the most significant bit in an 8, 4, 2, 1 BCD code. For this reason a fault is most likely to be evident at point 8 and bit 8 is most likely to have a negative error, as shown. To bring bit 8 back to its proper value so that the waveform follows the dashed line, the effective resistance across R18 and R34, which are in parallel must be reduced, proceed as follows:

a. Remove R34.

b. Connect a decade resistance box across R18.

c. Adjust the resistance box until the proper triangular wave is obtained.

Figure 4-1. Correct Triangular Output Waveform

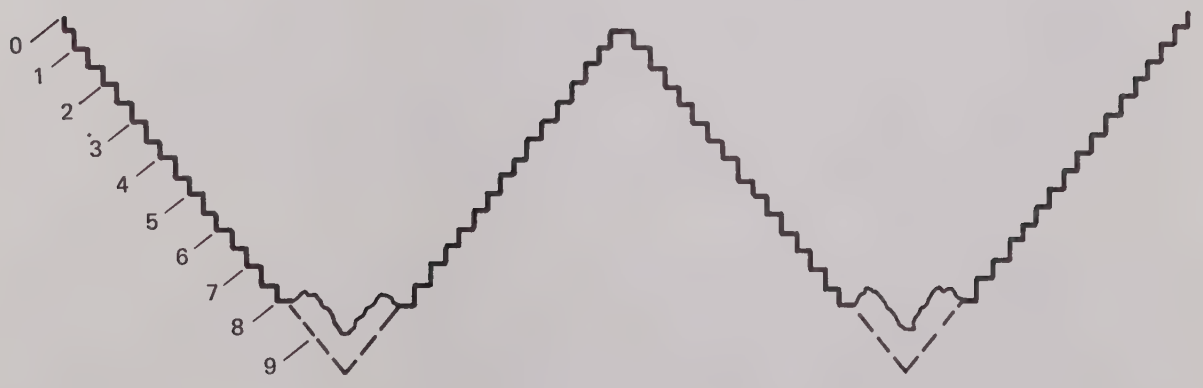



Figure 4-2. Incorrect Output Waveform

d. Select a standard resistor closest in value to the setting of the resistance box and solder it in place of R34.

e. Proceed to the following distortion test and adjustment procedure.

4.4.1.3 Distortion Check and Adjustment

a. Connect the distortion meter to the TG-1 output.

b. Set thumbwheel, f3, to 9000.0 Hz.

c. Set distortion meter frequency range to X1K position.

d. Connect oscilloscope to distortion meter output.

e. Obtain a display of the distortion meter output on the oscilloscope and observe that it is sinusoidal. If it is not, adjust potentiometers R22 and R24 on A1 as follows until the waveform is sinusoidal.

f. If the distortion meter reading is greater than 5%, adjust R22 for minimum distortion then adjust R24 for minimum distortion. (Check the distortion analyzer input level).

g. Adjust R22 for minimum distortion and then R24.

h. Repeat step g until distortion is less than 5% (typical value 2.5%).

i. Using the oscilloscope, adjust R103 on the Carrier Board, A4, for an output level of 1.1 Vrms ±2% (approximately 3V p-p).

4.4.2 Frequency Synthesizer Board, A2

a. Repeat paragraph 4.4.1.1 steps a through g, except use MODE f1, f'2, f3 at step c and set thumbwheel, f2, to 9000.0 Hz at step f.

b. Repeat paragraph 4.4.1.2 steps a through e and paragraph 4.4.1.3 steps a through i, except adjust R104 at step i.

4.4.3 Frequency Synthesizer Board, A3

a. Repeat paragraph 4.4.1.1 steps a through e, except use MODE f1 at step c and set thumbwheel, f1, to 9000.0 Hz at step f.

b. Repeat paragraph 4.4.1.2 steps a through e and paragraph 4.4.1.3 steps a through i, except adjust R102 at step i.

## 4.5 TIMING CHECK AND ADJUSTMENT PROCEDURES

### 4.5.1 First Burst (set pause, second burst, and repeat delay to minimum)

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1→f2 to In position.

c. Push START switch to begin cycling.

d. Turn FIRST BURST switch to X1 position.

e. Turn FIRST BURST control to max ccw position.

f. Connect oscilloscope probe to terminal E18 (amp terminal) on front of Carrier Board, A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to the reference voltage (0V) should be 0.1 second. If it is not, adjust R6 on A4.

h. Turn FIRST BURST control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 1.0 second ±20%. If the pulse width is less than 0.8 seconds, replace capacitor C1 on A4. If the pulse width is greater than 1.2 seconds, add a resistor across FIRST BURST control of such a value that it will shorten the pulse to within the specified timing range.

j. Set FIRST BURST switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 10 second ±20%. If the pulse is shorter than 8.0 seconds, replace capacitor C2 on A4. If the pulse is longer than 12 seconds, add a resistor across FIRST BURST control of such a value that it will shorten the pulse to within the specified timing range.

### 4.5.2 Pause

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1→f2 to In position.

c. Push START switch.

d. Set PAUSE switch to X1 position.

e. Rotate PAUSE control to max ccw position.

f. Connect oscilloscope probe to terminal E30 on Carrier Board A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to the reference voltage (0V) should be 0.1 seconds. If it is not, adjust R7 on A4.

h. Turn PAUSE control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 1.0 seconds ±20%. If the pulse width is less than 0.8 seconds, replace capacitor C3 on A4. If the pulse width is greater than 1.2 seconds, add a resistor across PAUSE control of such a value that it will shorten the pulse to within the specified timing range.

j. Set PAUSE switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 10 seconds ±20%. If the pulse is shorter than 8.0 seconds, replace capacitor C4 on A4. If the pulse is longer than 12.0 seconds, add a resistor across PAUSE control of such a value that it will shorten the pulse to within the specified timing range.

4.5.3 Second Burst

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1 → f2 to In position.

c. Push START switch.

d. Set SECOND BURST switch to X1 position.

e. Rotate SECOND BURST control to max ccw position.

f. Connect oscilloscope probe to terminal E21 on A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to reference voltage (0V) should be 0.1 seconds. If it is not, adjust R9 on A4.

h. Rotate SECOND BURST control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 1.0 seconds ±20%. If the pulse width is less than 0.8 seconds, replace capacitor C7 on A4. If the pulse width is greater than 1.2 seconds, add a resistor across SECOND BURST control of such a value that it will shorten the pulse to within the specified timing range.

j. Set SECOND BURST switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 10 seconds ±20%. If the pulse is shorter than 8.0 seconds, replace capacitor C8 on A4. If the pulse length is longer than 12.0 seconds, add a resistor across SECOND BURST control of such a value that it will shorten the pulse to within the specified timing range.

4.5.4 Repeat Delay

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1→f2 to In position.

c. Push START switch.

d. Set REPEAT DELAY switch to X1 position.

e. Rotate REPEAT DELAY control to max ccw position.

f. Connect oscilloscope probe to terminal E32 on A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to reference voltage (0V) should be 0.5 seconds. If it is not, adjust R8 on A4.

h. Rotate REPEAT DELAY control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 5 seconds ±20%. If the pulse width is less than 4.0 seconds, replace capacitor C5 on A4. If the pulse width is greater than 6.0 seconds, add a resistor across REPEAT DELAY control of such a value that it will shorten the pulse to within the specified timing range.

j. Turn REPEAT DELAY switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 50 seconds ±20%. If the pulse is shorter than 40 seconds, replace capacitor C6 on A4. If the pulse is longer than 60 seconds, add a resistor across REPEAT DELAY control of such a value that it will shorten the pulse to within the specified timing range.

## 4.6 FREQUENCY ACCURACY TEST

### 4.6.1 Frequency, f1, Test (all models)

a. Connect 600 Ω OUTPUT of TG-1 to electronic counter.

b. Set the OUTPUT control of TG-1 to maximum cw position.

c. Select MODE f1.

d. Set the thumbwheel switch, f1, to 7777.7 Hz.

e. Set FIRST BURST switch to CONT. position.

f. Set the function switch of electronic counter to "Frequency" 10 kHz.

g. Set the sensitivity of electronic counter to 1.0 position.

h. Reset the counter.

i. Counter should indicate 7.7777 kHz ±0.1 Hz.

j. Set the thumbwheel switch, f1, to 8888.8 Hz.

k. Reset the counter.

l. Counter should indicate 8.8888 kHz ±0.1 Hz.

### 4.6.2 Frequency, f2, Test (TG-1B, and TG-1C only)

a. Connect 600 Ω OUTPUT of TG-1 to electronic counter.

b. Set the LEVEL control of TG-1 to maximum cw position.

c. Select mode f1→f2.

d. Set IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

e. Set the thumbwheel switch, f2, to 7777.7 Hz. (All other thumbwheels to zero position).

f. Set the FIRST BURST switch to X1 position, and FIRST BURST control to the mid-range position.

g. Set the PAUSE switch to ZERO position.

h. Set the SECOND BURST switch to X10 position, and SECOND BURST control to maximum cw position.

i. Set REPEAT DELAY switch to ZERO position.

j. Set the function switch of electronic counter to "Frequency 10 kHz".

k. Set the sensitivity of electronic counter to 1.0 position.

l. Press START switch of TG-1. At the very beginning of SECOND BURST (light on) reset the counter.

m. Indication should be 7.7777 kHz ±0.1 Hz.

n. Set the thumbwheel switch, f2, to 8888.8 Hz.

o. Indication should be 8.8888 kHz ±0.1 Hz.

4.6.3 Frequency, f3, Test (TG-1B, and TG-1C only)

The procedure for frequency accuracy test is similar to frequency f2 test given in paragraph 4.6.2 with the following exceptions:

a. Select MODE f1, f3.

b. Set the thumbwheel switch, f3, to 7777.7 Hz or 8888.8 Hz.

c. All other thumbwheel switches should be in zero position.

4.6.4 Frequency, f4, Test (TG-1B, and TG-1C only)

a. Connect 600 Ω OUTPUT of TG-1 to electronic counter.

b. Set the LEVEL control of TG-1 to maximum cw position.

c. Select MODE $\begin{bmatrix} f1 \\ f3 \end{bmatrix} \rightarrow \begin{bmatrix} f2 \\ f4 \end{bmatrix}$.

d. Push switch IN-REPEAT/OUT-SINGLE to IN-REPEAT position.

e. Set the thumbwheel switch, f4, (SW18) to 7777.7 Hz. (All other thumbwheels in zero position).

f. Set FIRST BURST switch to X1 position, and FIRST BURST control to the middle position.

g. Set the PAUSE switch to ZERO position.

h. Set the SECOND BURST switch to X10 position, and SECOND BURST control to maximum cw position.

i. Set the REPEAT DELAY switch to ZERO position.

j. Set the function switch of electronic counter to "Frequency 10 kHz".

k. Set the sensitivity of electronic counter to 1.0 position.

l. Press START switch TG-1. At the very beginning of SECOND BURST (light on) reset the counter.

m. Indication should be 7.7777 kHz ±0.1 Hz.

n. Set the thumbwheel switch, f4, (SW18) to 8888.8 Hz.

o. Indication should be 8.8888 kHz ±0.1 Hz.

Section V

# SCHEMATIC DIAGRAMS

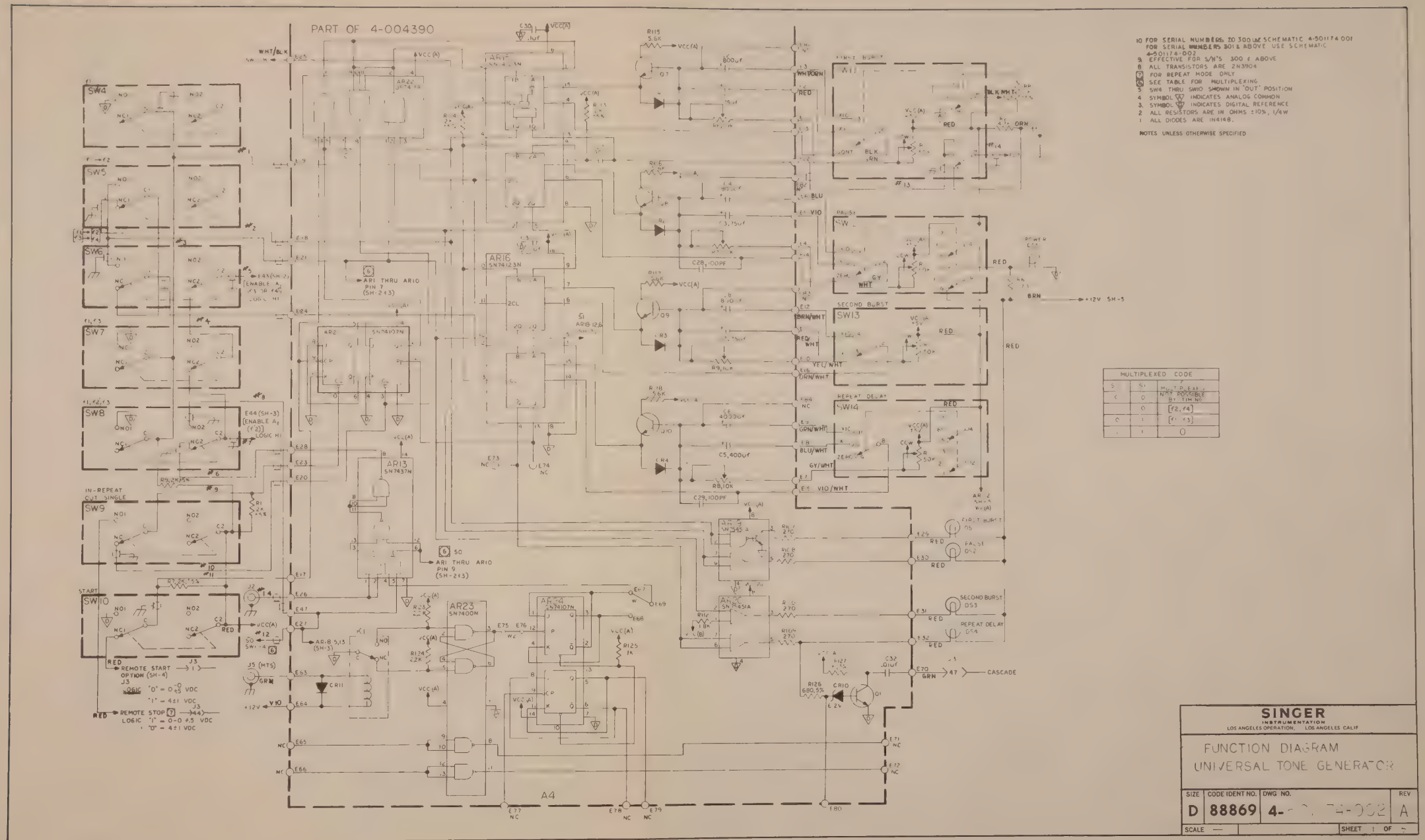

PART OF 4-004390
NOTES UNLESS OTHERWISE SPECIFIED
1. ALL DIODES ARE IN4148.
2. ALL RESISTORS ARE IN OHMS ±10%, 1/4W
3. SYMBOL ▽ INDICATES DIGITAL REFERENCE
4. SYMBOL ▽ INDICATES ANALOG COMMON
5. SW4 THRU SW10 SHOWN IN "OUT" POSITION
6. SEE TABLE FOR MULTIPLEXING
7. FOR REPEAT MODE ONLY
8. ALL TRANSISTORS ARE 2N3904
9. EFFECTIVE FOR S/N'S 300 & ABOVE
10. FOR SERIAL NUMBERS 300 USE SCHEMATIC 4-501174-001
FOR SERIAL NUMBERS 301 & ABOVE USE SCHEMATIC 4-501174-002
MULTIPLEXED CODE
SINGER
INSTRUMENTATION
LOS ANGELES OPERATION, LOS ANGELES CALIF
FUNCTION DIAGRAM
UNIVERSAL TONE GENERATOR
SIZE D
CODE IDENT NO. 88869
DWG NO. 4-[illegible]-002
REV A
SCALE —
SHEET 1 OF —

Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 1 of 5)

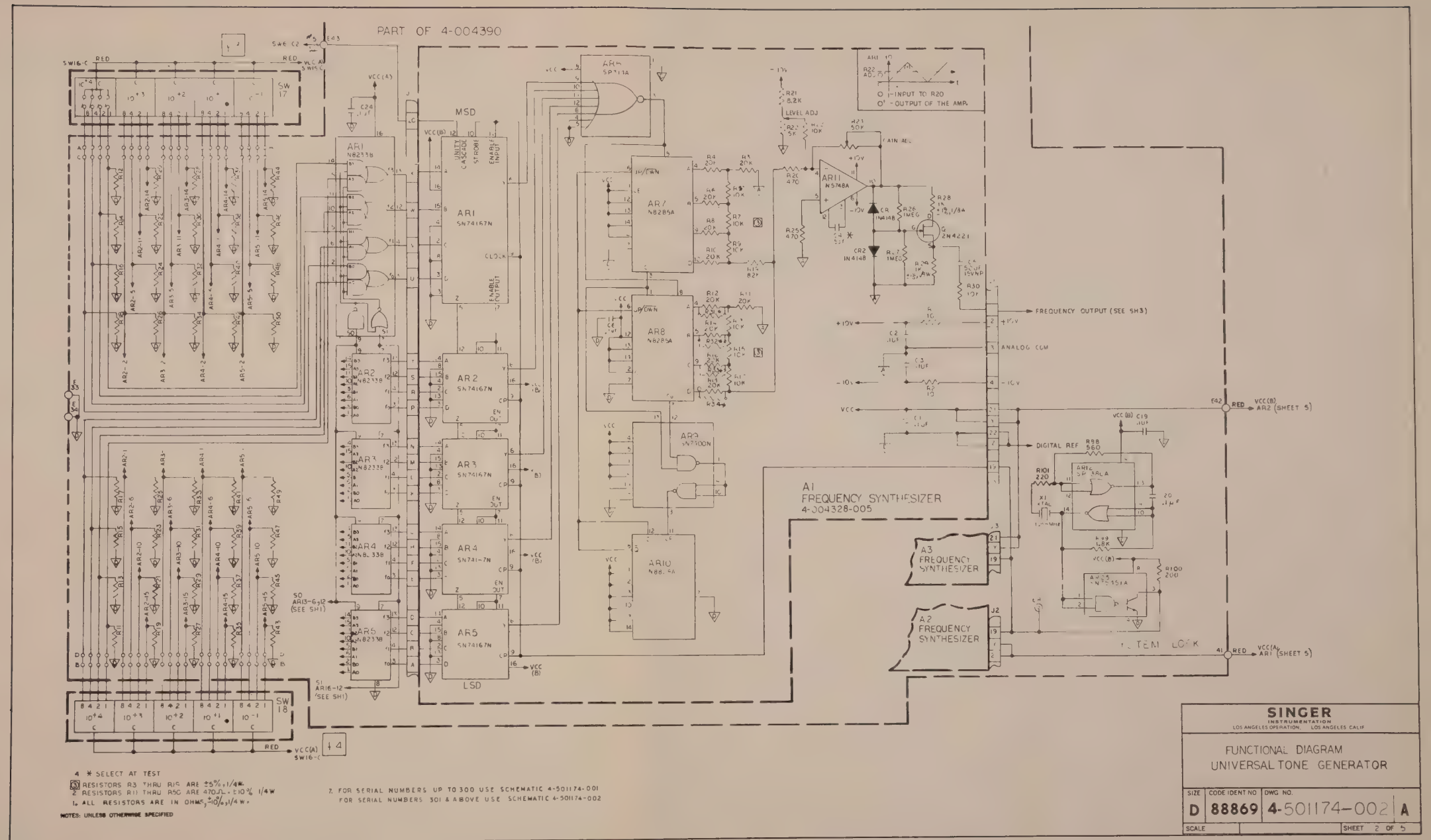



Figure 5-1. Universal Tone Generator
Functional Diagram (Sheet 2 of 5)

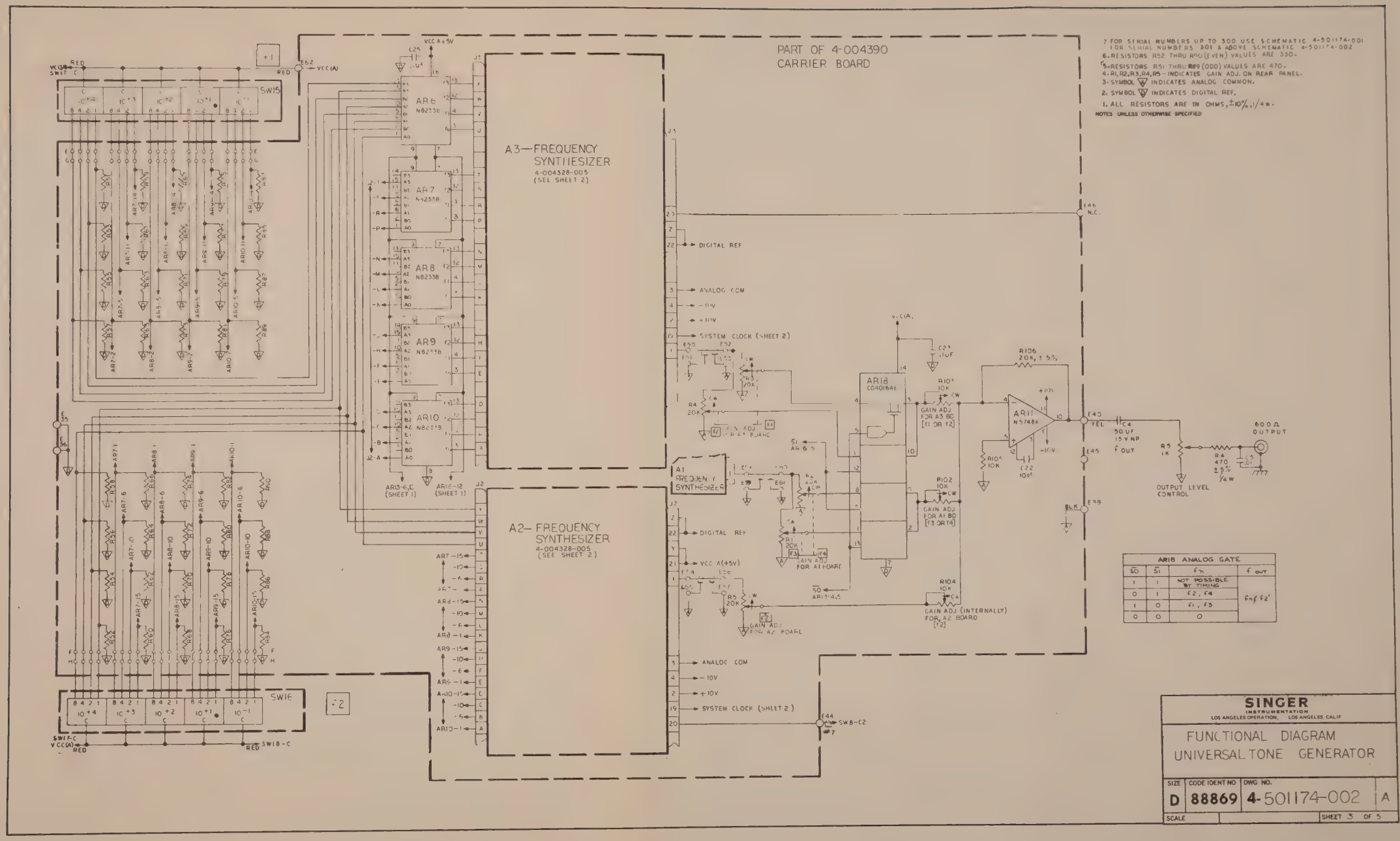
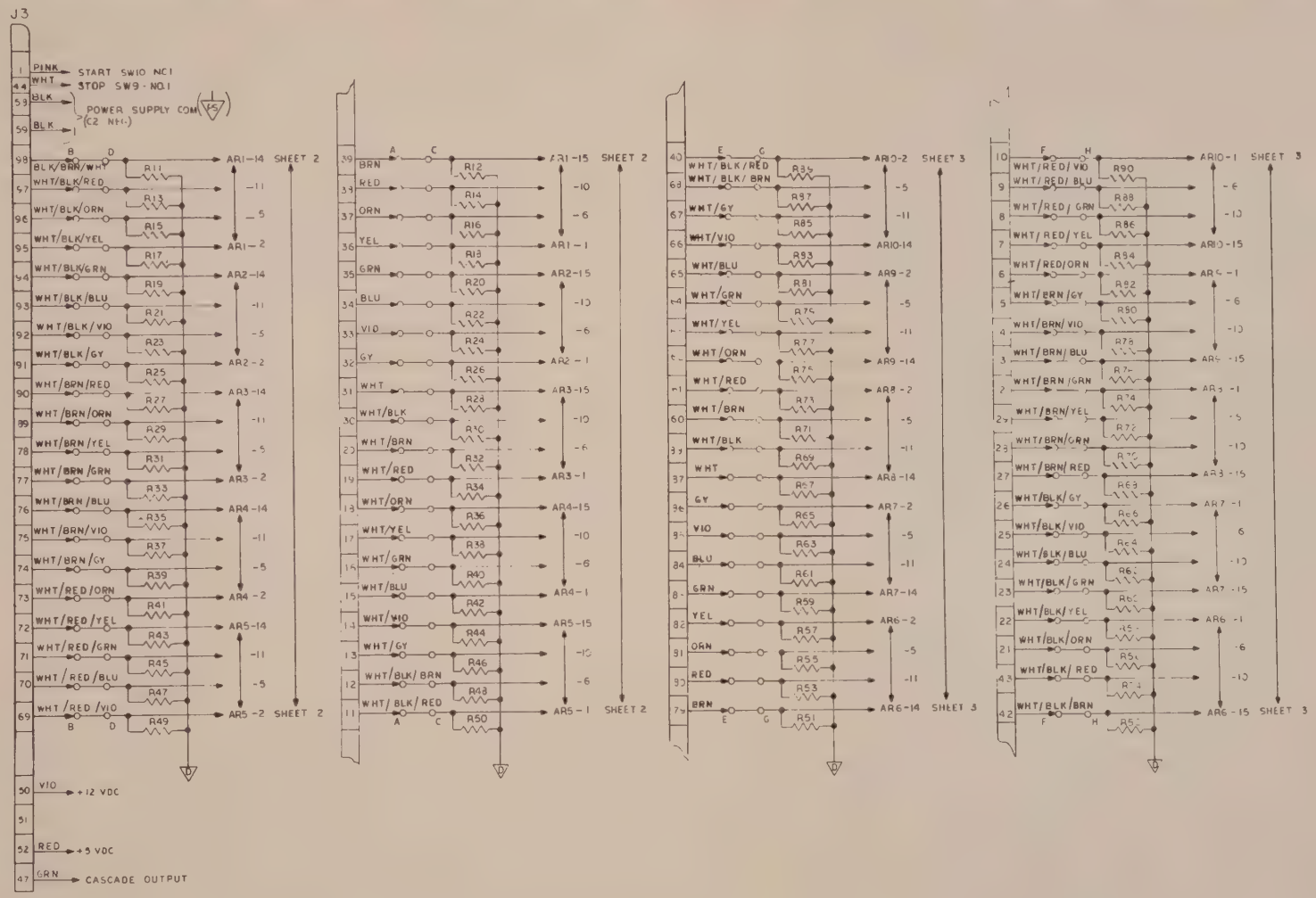



Figure 5-1. Universal Tone Generator
Functional Diagram (Sheet 3 of 5)



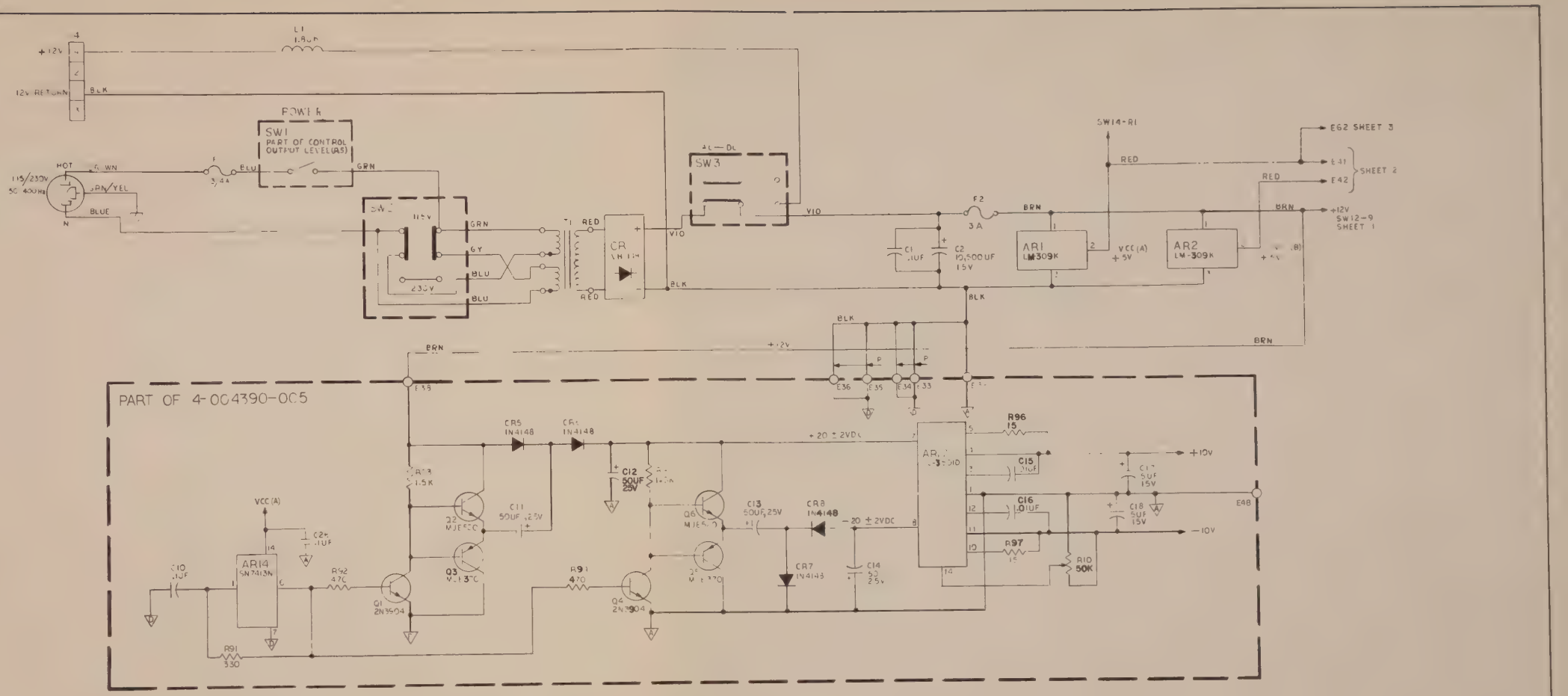

SPARE: 41,45,46,48,49, 51, 53, 54,55, 56, 57

4. FOR SERIAL NUMBERS UP TO 300 USE SCHEMATIC 4-501174-001
   FOR SERIAL NUMBERS 301 & ABOVE USE SCHEMATIC 4-501174-002
3. FOR RESISTOR VALUE SEE SHEETS 2 AND 3.
2. SYMBOL (D) INDICATES DIGITAL REFERENCE.
1. SYMBOL (PS) INDICATES POWER SUPPLY COMMON

NOTES: UNLESS OTHERWISE SPECIFIED

| | | | |
|---|---|---|---|
| SINGER INSTRUMENTATION LOS ANGELES OPERATION, LOS ANGELES, CALIF | | | |
| FUNCTIONAL DIAGRAM UNIVERSAL TONE GENERATOR | | | |
| SIZE D | CODE IDENT NO. 88869 | DWG NO. 4-501174-002 | A |
| SCALE | | SHEET 4 OF 5 | |

Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 4 of 5)




6. FOR SERIAL NUMBERS UP TO 300 USE SCHEMATIC 4-501174-001
FOR SERIAL NUMBERS 301 & ABOVE USE SCHEMATIC 4-501174-002

5. SYMBOL PS INDICATES POWER SUPPLY COMMON.

4. SYMBOL INDICATES CHASSIS GND.

3. SYMBOL INDICATES ANALOG COMMON.

2. SYMBOL INDICATES DIGITAL REF.

1. ALL RESISTORS ARE IN OHMS ±10%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED

| SINGER INSTRUMENTATION LOS ANGELES OPERATION, LOS ANGELES, CALIF | | | |
|---|---|---|---|
| FUNCTIONAL DIAGRAM UNIVERSAL TONE GENERATOR | | | |
| SIZE | CODE IDENT NO. | DWG NO. | |
| D | 88869 | 4-501174-002 | A |
| SCALE | | SHEET 5 OF 5 | |

Figure 5-1. Universal Tone Generator
Functional Diagram (Sheet 5 of 5)

# Section VI

# PARTS LIST

TG-1, TONE GENERATOR, MAJOR ASSEMBLIES, PARTS LIST

| REFERENCE DESIGNATOR | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| A1 | Frequency Synthesizer Board | 4-004328-005 | | |
| A2 | Same as A1 | | | |
| A3 | Same as A1 | | | |
| A4 | Carrier Board | 4-004390-008 | | |

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST

| REFERENCE DESIGNATOR | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| AR1 | Integrated circuit, +5 VDC regulator | 1-926038-002 | NS | LM-309K |
| AR2 | Same as AR1 | | | |
| C1 | Capacitor, met plastic 0.1 μf | 1-900001-013 | Amperex | C280AE |
| C2 | Capacitor, elect, 10,500 μf | 1-900073-002 | Mallory | CG1052015K1 |
| C3 | Same as C1 | | | |
| C4 | Capacitor, elect, 50 μf, 15VNP | 1-900060-001 | GI | 98416NP |
| C5 | Capacitor, met plastic, 0.01 μf | 1-900001-001 | Amperex | C280AE |
| CR1 | Diode bridge rect, epoxy | 1-913040-001 | Varo | VH148TT |
| DS1 | Indicator light (green) | 1-925006-002 | Mura | L-10/20 |
| DS2 | Same as DS1 | | | |
| DS3 | Same as DS1 | | | |
| DS4 | Same as DS1 | | | |
| DS5 | Indicator light (red) | 1-925007-003 | Mura | L-10/20 |
| F1 | Fuse, 3/4A | 1-924000-017 | Bussmann | Type MDL |
| F2 | Fuse, 3A | 1-924000-027 | Bussmann | Type MDL |
| J1 | Jack, phone | 1-910026-001 | Switchcraft | Type 3C1054A |
| J2 | Same as J1 | | | |
| J3 | Connector, receptacle | 1-910194-002 | Singer | 1-910194-002 |
| P3 Mate | Connector, plug | 1-910194-001 | Singer | 1-910194-001 |
| J4 | Connector, plug | 1-910179-002 | Cinch Jones | P-304-DB |
| J5 | Same as J1 | | | |
| L1 | Choke, 1.8 μf | 1-906009-001 | | |
| P1 | Cord, power | 1-910166-001 | Belden | KH7375 |

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST (contd)

| REFERENCE DESIGNATOR | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| R1 | Resistor, comp, 2K ±5%, 1/4w | 1-945000-169 | Allen Bradley | Type CB |
| R2 | Resistor, comp, 4.7K ±10%, 1/4w | 1-945000-045 | Allen Bradley | Type CB |
| R3 | Not used | | | |
| R4 | Resistor, 470 ohms ±5%, 1/4w | 1-945000-154 | Allen Bradley | Type CB |
| R5 | Resistor, variable 1K pot/switch S1 | 1-403343-001 | Allen Bradley | Type CB |
| R6 | Resistor, comp, 270 ohms ±10%, 1/4w | 1-945000-030 | Allen Bradley | Type CB |
| R7 | Same as R1 | | | |
| R8 | Same as R1 | | | |
| R9 | Same as R1 | | | |
| S1 | Switch/variable resistor (see R5) | | | |
| S2 | Switch, slide (115/230) | 1-951003-001 | Switchcraft | Type 46206LF |
| S3 | Switch, slide (AC-DC) | 1-951003-001 | Switchcraft | Type 46206LF |
| S4 | Switch, pushbutton assembly | 1-951020-002 | IEE | TXF17.5SB/ BLK-2U-GR |
| S5 | Same as S4 | | | |
| S6 | Same as S4 | | | |
| S7 | Same as S4 | | | |
| S8 | Same as S4 | | | |
| S9 | Same as S4 | | | |
| S10 | Same as S4 | | | |
| S11 | Switch, pot concentric | 1-003407-004 | | |
| S12 | Same as S11 | | | |
| S13 | Switch, pot concentric | 1-003407-005 | | |
| S14 | Same as S11 | | | |
| S15 | Thumbwheel Switch | 1-951039-001 | Digitran | 29-5-2 |
| S16 | Same as S15 | | | |
| S17 | Same as S15 | | | |
| S18 | Same as S15 | | | |
| T1 | Transformer, power | 1-403314-001 | | |

TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST

| REFERENCE DESIGNATOR | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| AR1 | Integrated cct, decade rate scaler | 1-926007-011 | TI | SN74167N |
| AR2 | Same as AR1 | | | |
| AR3 | Same as AR1 | | | |
| AR4 | Same as AR1 | | | |
| AR5 | Same as AR1 | | | |
| AR6 | Integrated cct, 7-input nor gate | 1-926018-003 | Signetics | SP314A |
| AR7 | Integrated cct, decade up/down counter | 1-926047-003 | Signetics | N8285A |
| AR8 | Same as AR7 | | | |
| AR9 | Integrated cct, 2-input nand gate | 1-926007-001 | TI | SN7400N |
| AR10 | Integrated cct, D-input F.F. | 1-926047-001 | Signetics | N8828N |
| AR11 | Integrated cct, operational amplifier | 1-926048-001 | Signetics | N5748A |
| C1 | Capacitor, net plastics, 0.1 μf | 1-900001-013 | Amperex | C280AE |
| C2 | Same as C1 | | | |
| C3 | Same as C1 | | | |
| C4 | Capacitor, dipped mica(5 AT)5 pF | 1-900003-004 | EMM | DM15 |
| C5 | Capacitor, elect, non-polar 50 μf, 15V | 1-900060-001 | GI | 984-16NP |
| C6 | Same as C1 | | | |
| CR1 | Diode | 1-913007-002 | | 1N4148 |
| CR2 | Same as CR1 | | | |
| Q1 | Transistor, field effect | 1-958052-001 | Motorola | 2N4221 |
| R1 | Resistor, comp, 10 ohm ±10%, 1/4w | 1-945000-013 | Allen Bradley | Type CB |
| R2 | Same as R1 | | | |
| R3 | Resistor, comp, 20K±5%, 1/4w | 1-945000-193 | Allen Bradley | Type CB |
| R4 | Same as R3 | | | |
| R5 | Resistor, film, 10K±1%, 1/8w | 1-945016-289 | | |
| R6 | Same as R3 | | | |
| R7 | Resistor, comp, 10K±5%, 1/4w | 1-945000-186 | Allen Bradley | Type CB |
| R8 | Same as R3 | | | |
| R9 | Same as R5 | | | |
| R10 | Same as R3 | | | |

TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST (contd)

| REFERENCE DESIGNATOR | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|
| R11 | Same as R3 | | | |
| R12 | Same as R3 | | | |
| R13 | Same as R7 | | | |
| R14 | Same as R3 | | | |
| R15 | Same as R7 | | | |
| R16 | Same as R3 | | | |
| R17 | Same as R7 | | | |
| R18 | Same as R3 | | | |
| R19 | Resistor, comp, 82K ±5%, 1/4w | 1-945000-208 | Allen Bradley | Type CB |
| R20 | Resistor, comp, 470 ohms ±10%, 1/4w | 1-945000-033 | Allen Bradley | Type CB |
| R21 | Resistor, comp, 8.2K ±10%, 1/4w | 1-945000-048 | Allen Bradley | Type CB |
| R22 | Resistor, variable 20 turn 5K | 1-945093-001 | | |
| R23 | Resistor, comp, 10K ±10%, 1/4w | 1-945000-049 | Allen Bradley | Type CB |
| R24 | Resistor, variable, 50K | 1-956010-009 | CTS | Type 201 |
| R25 | Same as R20 | | | |
| R26 | Resistor, comp, 1 Meg ±10%, 1/4w | 1-945000-073 | Allen Bradley | Type CB |
| R27 | Same as R26 | | | |
| R28 | Resistor, film 1K ±10%, 1/8w | 1-945016-193 | | |
| R29 | Same as R28 | | | |
| R30 | Same as R23 | | | |
| R31 | Resistor, comp, ±5% (selected) | 1-945000- | Allen Bradley | Type CB |
| R32 | Resistor, comp, ±5% (selected) | 1-945000- | Allen Bradley | Type CB |
| R33 | Resistor, comp, ±5% (selected) | 1-945000- | Allen Bradley | Type CB |
| R34 | Resistor, comp, ±5% (selected) | 1-945000- | Allen Bradley | Type CB |

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

| REFERENCE DESIG. | APPLICABLE MODELS | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|---|
| AR1 | TG-1B<br>-1C<br>-1BP<br>-1CP | Integrated cct, 2-input 4 Bit Digital multiplexer | 1-926047-002 | Signetics | N8233B |
| AR2 | TG-1B<br>-1C<br>-1BP<br>-1CP | Same as AR1 | | | |
| AR3 | TG-1B<br>-1C<br>-1BP<br>-1CP | Same as AR1 | | | |
| AR4 | TG-1B<br>-1C<br>-1BP<br>-1CP | Same as AR1 | | | |
| AR5 | TG-1B<br>-1C<br>-1BP<br>-1CP | Same as AR1 | | | |
| AR6 | All | Same as AR1 | | | |
| AR7 | All | Same as AR1 | | | |
| AR8 | All | Same as AR1 | | | |
| AR9 | All | Same as AR1 | | | |
| AR10 | All | Same as AR1 | | | |
| AR11 | All | Integrated cct, operational amplifier | 1-926048-001 | Signetics | N5748A |
| AR12 | All | Integrated cct, 2-input positive nand gate | 1-926018-002 | Signetics | SP380A |
| AR13 | All | Integrated cct, 2-input positive nand gate | 1-926007-006 | TI | SN7437N |
| AR14 | All | Integrated cct, dual nand schmitt trigger | 1-926007-005 | TI | SN7413N |
| AR15 | All | Integrated cct, retriggerable monostable multivibrator with clear | 1-926007-007 | TI | SN74123N |
| AR16 | All | Same as AR15 | | | |
| AR17 | All | Integrated cct, ±10 VDC regulator | 1-926049-001 | Signetics | SG3501D |
| AR18 | All | Integrated cct, quad spst mos analog switch | 1-926050-001 | RCA | CD4016AE |
| AR19 | All | Integrated cct, dual positive and driver | 1-926051-001 | TI | SN75451A |
| AR20 | All | Same as AR19 | | | |
| AR21 | All | Integrated cct, J-K input flip-flop | 1-926007-012 | TI | SN74107N |
| AR22 | All | Integrated cct, 3-input and gate | 1-926053-001 | Sprague | US7411A |
| AR23 | All | Integrated cct, 2-input nand gate | 1-926007-001 | TI | SN7400N |
| AR24 | All | Same as AR21 | | | |

| REFERENCE DESIG. | APPLICABLE MODELS | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|---|
| AR25 | All | Integrated cct | 1-926051-001 | TI | SN75951A |
| C1 | All | Capacitor, elect, 75 µf±10% 3V | 1-900106-001 | Callins | 2-85-ASD-75-3NP |
| C2 | All | Capacitor, elect, 800 µf±10% 3V | 1-900106-002 | Callins | 12-85-ASD-800-3NP |
| C3 | All | Same as C1 | | | |
| C4 | All | Same as C2 | | | |
| C5 | All | Capacitor, elect, 400 µf ±10% 3V | 1-900106-003 | Callins | 8-85-ADS-400-3NP |
| C6 | All | Capacitor, elect, 4000 µf ±10% 3V | 1-900107-001 | Callins | 10-85-PSD-4000-3NP |
| C7 | All | Same as C1 | | | |
| C8 | All | Same as C2 | | | |
| C9 | | Not used | | | |
| C10 | All | Capacitor, met plastic, 0.1 µf | 1-900001-013 | Amperex | C280AE |
| C11 | All | Capacitor, elect, 50 µf, 25V | 1-900039-005 | GI | 984-122 |
| C12 | All | Same as C11 | | | |
| C13 | All | Same as C11 | | | |
| C14 | All | Same as C11 | | | |
| C15 | All | Capacitor, met plastic, 0.1 µf | 1-900001-001 | Amperex | C280AE |
| C16 | All | Same as C15 | | | |
| C17 | All | Capacitor, elect, 5 µf, 15V | 1-900039-007 | GI | 984-9 |
| C18 | All | Same as C17 | | | |
| C19 | All | Same as C10 | | | |
| C20 | All | Same as C10 | | | |
| C21 | All | Not Used | | | |
| C22 | All | Capacitor, mica, 10 pF±5% 500V | 1-900003-008 | EMM | DM15 |
| C23 | All | Same as C10 | | | |
| C24 | All | Same as C10 | | | |
| C25 | All | Same as C10 | | | |
| C26 | All | Same as C10 | | | |
| C27 | All | Capacitor, mica, 1000pF ±5% | 1-900003-056 | EMM | DM15 |
| C28 | All | Capacitor, mica, 100pF ±5% | 1-900003-030 | EMM | DM15 |
| C29 | All | Same as C28 | | | |
| C32 | All | Same as C15 | | | |

| REFERENCE DESIG. | APPLICABLE MODELS | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|---|
| CR1 | All | Diode, Silicon | 1-913007-002 | | 1N4148 |
| CR2 | All | Same as CR1 | | | |
| CR3 | All | Same as CR1 | | | |
| CR4 | All | Same as CR1 | | | |
| CR5 | All | Same as CR1 | | | |
| CR6 | All | Same as CR1 | | | |
| CR7 | All | Same as CR1 | | | |
| CR8 | All | Same as CR1 | | | |
| CR9 | | Not used | | | |
| CR10 | All | Zener 6.2V | 1-913003-212 | | |
| CR11 | All | Same as CR1 | | | |
| J1 | All | Connector, PC board | 1-910105-006 | USC | UPCRD22ST1 |
| J2 | All | Same as J1 | | | |
| J3 | All | Same as J1 | | | |
| Q1 | All | Transistor, NPN-silicon | 1-958000-001 | Motorola | 2N3904-5 |
| Q2 | All | Transistor, NPN-silicon | 1-958001-002 | Motorola | MJE520 |
| Q3 | All | Transistor, PNP-silicon | 1-958001-001 | Motorola | MJE370 |
| Q4 | All | Same as Q1 | | | |
| Q5 | All | Same as Q3 | | | |
| Q6 | All | Same as Q2 | | | |
| Q7 | All | Same as Q1 | | | |
| Q8 | All | Same as Q1 | | | |
| Q9 | All | Same as Q1 | | | |
| Q10 | All | Same as Q1 | | | |
| Q11 | All | Same as Q1 | | | |
| R1 | All | Resistor, variable 20K | 2-403320-001 | | |
| R2 | All | Same as R1 | | | |
| R3 | All | Same as R1 | | | |
| R4 | All | Same as R1 | | | |
| R5 | All | Same as R1 | | | |
| R6 | All | Resistor, variable 10K | 1-945007-007 | CTS | Type X201 |
| R7 | All | Same as R6 | | | |
| R8 | All | Same as R6 | | | |
| R9 | All | Same as R6 | | | |
| R10 | All | Resistor, variable 50K | 1-945007-009 | CTS | Type X201 |
| R11 | All | Resistor, comp, 470 ohm ±10%, 1/4w | 1-945000-033 | Allen Bradley | Type CB |

| REFERENCE DESIG. | APPLICABLE MODELS | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|---|
| R12 | All | Same as R11 | | | |
| R13 | All | Same as R11 | | | |
| R14 | All | Same as R11 | | | |
| R15 | All | Same as R11 | | | |
| R16 | All | Same as R11 | | | |
| R17 | All | Same as R11 | | | |
| R18 | All | Same as R11 | | | |
| R19 | All | Same as R11 | | | |
| R20 | All | Same as R11 | | | |
| R21 | All | Same as R11 | | | |
| R22 | All | Same as R11 | | | |
| R23 | All | Same as R11 | | | |
| R24 | All | Same as R11 | | | |
| R25 | All | Same as R11 | | | |
| R26 | All | Same as R11 | | | |
| R27 | All | Same as R11 | | | |
| R28 | All | Same as R11 | | | |
| R29 | All | Same as R11 | | | |
| R30 | All | Same as R11 | | | |
| R31 | All | Same as R11 | | | |
| R32 | All | Same as R11 | | | |
| R33 | All | Same as R11 | | | |
| R34 | All | Same as R11 | | | |
| R35 | All | Same as R11 | | | |
| R36 | All | Same as R11 | | | |
| R37 | All | Same as R11 | | | |
| R38 | All | Same as R11 | | | |
| R39 | All | Same as R11 | | | |
| R40 | All | Same as R11 | | | |
| R41 | All | Same as R11 | | | |
| R42 | All | Same as R11 | | | |
| R43 | All | Same as R11 | | | |
| R44 | All | Same as R11 | | | |

| REFERENCE DESIG. | APPLICABLE MODELS | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|---|
| R45 | All | Same as R11 | | | |
| R46 | All | Same as R11 | | | |
| R47 | All | Same as R11 | | | |
| R48 | All | Same as R11 | | | |
| R49 | All | Same as R11 | | | |
| R50 | All | Same as R11 | | | |
| R51 | All | Same as R11 | | | |
| R52 | All | Resistor, comp, 330 ohm ±10%, 1/4w | 1-945000-031 | Allen Bradley | Type CB |
| R53 | All | Same as R11 | | | |
| R54 | All | Same as R52 | | | |
| R55 | All | Same as R11 | | | |
| R56 | All | Same as R52 | | | |
| R57 | All | Same as R11 | | | |
| R58 | All | Same as R52 | | | |
| R59 | All | Same as R11 | | | |
| R60 | All | Same as R52 | | | |
| R61 | All | Same as R11 | | | |
| R62 | All | Same as R52 | | | |
| R63 | All | Same as R11 | | | |
| R64 | All | Same as R52 | | | |
| R65 | All | Same as R11 | | | |
| R66 | All | Same as R52 | | | |
| R67 | All | Same as R11 | | | |
| R68 | All | Same as R52 | | | |
| R69 | All | Same as R11 | | | |
| R70 | All | Same as R52 | | | |
| R71 | All | Same as R11 | | | |
| R72 | All | Same as R52 | | | |
| R73 | All | Same as R11 | | | |
| R74 | All | Same as R52 | | | |
| R75 | All | Same as R11 | | | |
| R76 | All | Same as R52 | | | |

| REFERENCE DESIG. | APPLICABLE MODELS | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|---|
| R77 | All | Same as R11 | | | |
| R78 | All | Same as R52 | | | |
| R79 | All | Same as R11 | | | |
| R80 | All | Same as R52 | | | |
| R81 | All | Same as R11 | | | |
| R82 | All | Same as R52 | | | |
| R83 | All | Same as R11 | | | |
| R84 | All | Same as R52 | | | |
| R85 | All | Same as R11 | | | |
| R86 | All | Same as R52 | | | |
| R87 | All | Same as R11 | | | |
| R88 | All | Same as R52 | | | |
| R89 | All | Same as R11 | | | |
| R90 | All | Same as R52 | | | |
| R91 | All | Same as R52 | | | |
| R92 | All | Same as R11 | | | |
| R93 | All | Resistor, comp, 1.5K ±10%, 1/4w | 1-945000-039 | Allen Bradley | Type CB |
| R94 | All | Same as R11 | | | |
| R95 | All | Same as R93 | | | |
| R96 | All | Resistor, comp, 50 ohm ±5%, 1/4w | 1-945000-015 | | |
| R97 | All | Same as R96 | | | |
| R98 | All | Resistor, comp, 560 ohm ±5%, 1/4w | 1-945000-156 | Allen Bradley | Type CB |
| R99 | All | Resistor, comp, 1.8K ohm ±5%, 1/4w | 1-945000-186 | Allen Bradley | Type CB |
| R100 | All | Resistor, comp, 200 ohm ±5%, 1/4w | 1-945000-145 | Allen Bradley | Type CB |
| R101 | All | Resistor, comp, 220 ohm ±5%, 1/4w | 1-945000-146 | Allen Bradley | Type CB |
| R102 | All | Same as R6 | | | |
| R103 | All | Same as R6 | | | |
| R104 | All | Same as R6 | | | |
| R105 | All | Resistor, comp, 10K ±10%, 1/4w | 1-945000-049 | Allen Bradley | Type CB |

| REFERENCE DESIG. | APPLICABLE MODELS | DESCRIPTION | SINGER PART NUMBER | MANUFACTURER | MANUFACTURER PART NUMBER |
|---|---|---|---|---|---|
| R106 | All | Resistor, comp, 20K ±10%, 1/4w | 1-945000-193 | Allen Bradley | Type CB |
| R107 | All | Resistor, comp, 270 ohm ±10%, 1/4w | 1-945000-030 | Allen Bradley | Type CB |
| R108 | All | Same as R107 | | | |
| R109 | All | Same as R107 | | | |
| R110 | All | Same as R107 | | | |
| R111 | | Not used | | | |
| R112 | All | Resistor, comp, 1.8K ±5%, 1/4w | 1-945000-168 | | |
| R113 | All | Resistor, comp, 2K ±10%, 1/4w | 1-945000-041 | | |
| R114 | All | Resistor, comp, 2K ±5%, 1/4w | 1-945000-169 | | |
| R115 | All | Resistor, comp, 22K ±5%, 1/4w | 1-945001-194 | | |
| R116 | All | Same as R115 | | | |
| R117 | All | Same as R115 | | | |
| R118 | All | Same as R115 | | | |
| R119 | All | Not used | | | |
| R120 | All | Not used | | | |
| R121 | All | Not used | | | |
| R122 | All | Not used | | | |
| R123 | All | Same as R113 | | | |
| R124 | All | Same as R113 | | | |
| R125 | All | Resistor, comp, 1K ±5%, 1/4w | 1-945000-037 | | |
| R126 | All | Resistor, comp, 680 ohm ±5%, 1/4w | 1-945000-158 | | |
| R127 | All | Same as R125 | | | |
| K1 | All | Relay | 1-942014-003 | | |
| XAR1 thru XAR5 | All | Socket, Dual in-line | 1-950015-001 | | |
| XAR15 | All | Same as XAR1 thru XAR5 | | | |
| XAR16 | All | Same as XAR1 thru XAR5 | | | |
| XAR21 | All | Socket, Dual in-line | 1-950014-001 | Augat, Inc | 314AG502R |
| XAR22 | All | Same as XAR21 | | | |
| X1 | All | Crystal; 1.98 MHz | 1-403317-001 | | |

# APPENDIX A

# INSTALLATION PROCEDURE FOR UPGRADING TG-1

## A.1 INTRODUCTION

TG-1 may be upgraded in the field using factory prewired kits as follows:

| FROM | TO | KIT NUMBER |
|---|---|---|
| TG-1A | TG-1B | 1-004649-001 |
| TG-1A | TG-1C | 1-004650-001 |
| TG-1B | TG-1C | 4-004328-005 |
| TG-1 (A, B or C) | TG-1 (A, B or C) P | 1-004655-001 |

## A.2 UPGRADING TG-1A TO TG-1B (KIT NO. 1-004649-001)

a. Five integrated circuits N8233B plug into the sockets A4AR1 - A4AR5 on the Carrier Board (A4).

b. Remove cover on the front panel for f3 thumbwheel switch.

c. Install prewired thumbwheel (Harness No. 1).

d. Remove cover on the front panel for f4 thumbwheel switch.

e. Install prewired thumbwheel (Harness No. 2).

f. The amp terminals from the wires should be plugged on the Carrier Board terminals as shown in Figure 5-1, sheet 2.

g. Frequency synthesizer board (A1) (4-004328-005) plugs into the connector J1 on the Carrier Board (A4).

h. Perform calibration procedure described in paragraph 4.4.1.

## A.3 UPGRADING TG-1A to TG-1C (KIT NO. 1-004650-001)

a. Same as paragraph A-2 (a to g) above.

b. Frequency synthesizer board (A2) (4-004328-005) plugs into the connector J2 on the Carrier Board (A4).

c. Perform calibration procedure described in paragraphs 4.4.2 and 4.4.3.

## A.4 UPGRADING TG-1B TO TG-1C (KIT NO. 4-004328-005)

a. Frequency synthesizer board (A2) (4-004328-005) plugs into the connector J2 on the Carrier Board (A4).

b. Perform calibration procedure described in paragraph 4.4.3.

## A.5 UPGRADING TG-1A, B, OR C TO PROGRAMMABLE UNIT (KIT NO. 1-004655-001)

a. Remove cover on the rear panel for J3 connector.

b. Install prewired connector.

c. The amp terminals from the wires should be plugged onto the Carrier Board terminals as shown in Figure 5-1, sheet 4.

d. Set all front panel thumbwheel switches to zero position.

e. Perform calibration procedure described in paragraph 4.6 using remote switches.

## A.6 UPGRADING TG-1B FOR IMTS, MTS AND SECODE OUTPUT

The Universal Tone Generator TG-1B has the capability of producing all tone modes except three frequencies simultaneously (f1, f2', f3), Secode, MTS and IMTS because f2' cannot be generated. Frequency f2' cannot be generated because the unit does not contain an A2 frequency synthesizer board, (Singer P/N 4-004328-005). To convert the TG-1B for IMTS, MTS, and Secode operation, either one of two modifications may be made.

1. Add one new frequency synthesizer board to J2 connector. This modification converts TG-1B to TG-1C which has full capability.

2. Transfer frequency synthesizer board A1 (J1) to connector J2. Thus, the modified TG-1B is capable of generating f2' and therefore IMTS, MTS, and Secode. However, the TG-1B loses some of its standard capability.

Frequencies f3 and f4 cannot be generated and therefore, only the following modes may be performed: Single-tone f1; two-tone sequential f1 → f2; and two-tone simultaneous f1, f2'. Figure A-1 shows how to modify TG-1B, by transferring A1 to A2.

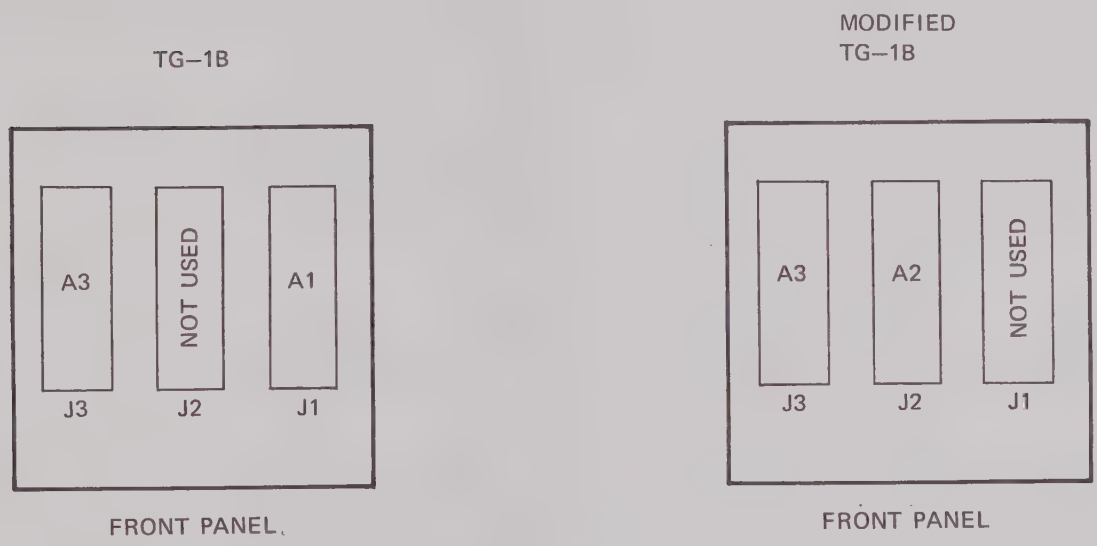



Figure A1. Modifying Model TG-1B for IMTS, MTS and Secode Output

ADDENDUM
For
Manual No. 1-500783-261
Model TG-1

ERRATA

Correct the following errors in the above manual;

Page 6-7:

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

Was:

| | | | | | |
|---|---|---|---|---|---|
| C15 | All | Capacitor, met plastic, 0.1 uF | 1-900001-001 | Amperex | C280AE |

Is:

| | | | | | |
|---|---|---|---|---|---|
| C15 | All | Capacitor, met plastic, 0.01 uF | 1-900001-001 | Amperex | C280AE |

Page 6-8: TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)
J1, MANUFACTURER PART NUMBER, Was: UPCRD22ST1 Is: UPCR-D22SDU-T1

Page 5-5/5-6: Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 2 of 5)
AR6-12, should be: AR6-4
AR6-4, should be: AR6-12

| Revision | Initials | Date | Approved |
|---|---|---|---|
| E | DM | | |
| D | | | |
| C | DM | | |
| B | DM | | |
| A | DM | 8/2/73 | DM |

| SINGER INSTRUMENTATION LOS ANGELES, CALIF. | TITLE ADDENDUM MODEL TG-1 | DWG NO. 1- 500783-261 SHEET 1.1 |
|---|---|---|

FORM NO. 160 1M 3-70 D-H

## RUNNING CHANGES

Perform the following changes to the above manual up to the serial number effectivity of your instrument

Effective serial number: 301 and above

Page 5-11/5-12:

Figure 5-1. Universal Tone Generator Function Diagram
R96, R97, Was: 15
Is: 10

Page 6-11:

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

Was:

| | | | | | |
|---|---|---|---|---|---|
| R96 | All | Resistor, comp., 50 ohm ±5%, 1/4 W | 1-945000-015 | ------ | ------- |

Is:

| | | | | |
|---|---|---|---|---|
| R96 | All | Resistor, comp., 10 ohm ±10%, 1/4 W | 1-945000-013 | Allen-Bradley Type CB |

Effective serial number: Serial numbers suffixed with 04030

Page 5-5/5-6: Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 2 of 5)
Add: C7, a 750 pF capacitor, from the junction of AR9-8 and AR10-11 to ground with the curved side to ground.

Page 6-4: TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST
Below C6, Add:

| | | | |
|---|---|---|---|
| C7 | Capacitor, mica, 750 pF, ±5%, 300 Vdc | 1-900003-053 | Electro Motive DM15 |

REVISED
APPROVED D.N. 6/21/74

| | | |
|---|---|---|
| SINGER INSTRUMENTATION LOS ANGELES, CALIF. | TITLE ADDENDUM MODEL TG-1 | DWG NO. I- 500783-261 SHEET 2.1 |

## RUNNING CHANGES

Perform the following changes to the above manual up to the serial number effectivity of your instrument.

Effective serial number: 301 and above

Page 5-11/5-12:
Figure 5-1. Universal Tone Generator Function Diagram
R96, R97, Was: 15
Is: 10

Page 6-11:

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (continued)

Was:

| | | | | | |
|---|---|---|---|---|---|
| R96 | All | Resistor, comp., 50 ohm ± 5%. 1/4 W | 1-945000-015 | ------ | ------ |

Is:

| | | | | | |
|---|---|---|---|---|---|
| R96 | All | Resistor, comp., 10 ohm ± 10%, 1/4 W | 1-945000-013 | Allen-Bradley | Type CB |

Effective serial number: Serial numbers suffixed with 04030

Page 5-5/5-6: Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 2 of 5)
Add: C7, a 750 pF capacitor, from the junction of AR9-8 and AR10-11 to ground with the curved side to ground.

Page 6-4: TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST
Below C6, Add:

| | | | | |
|---|---|---|---|---|
| C7 Capacitor, mica, 750pF, ± 5%, 300 Vdc | | 1-900003-053 | Electro Motive | DM 15 |

Effective serial number: Serial numbers prefixed with 500 and above

Page 5-5/5-6: Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 2 of 5)
R24, Was: 50K Is: 100K

Page 6-5: TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PART LIST (contd)

| | | | | |
|---|---|---|---|---|
| R24, Was: | Resistor, variable, 50K | 1-956010-009 | CTS | Type 201 |
| Is: | Resistor, variable, 100k | 1-945010-010 | CTS | Type 201 |

REVISED

APPROVED

CLASS CODE

| | | |
|---|---|---|
| SINGER INSTRUMENTATION LOS ANGELES, CALIF. | TITLE ADDENDUM MODEL TG-1 | DWG NO. 1- 500783-261 SHEET 2.2 |

## RUNNING CHANGES

Effective serial number: Serial numbers suffixed with 05279 and above

Page 5-5/5-6: Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 2 of 5)
R100, Was: 200 Is: 2.2 K

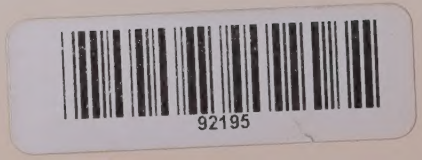
Page 6-11: TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (Contd)

| | | | | | |
|---|---|---|---|---|---|
| R100, Was: | All | Resistor, comp., 200 ohm, ±5%, 1/4 W | 1-945000-145 | Allen Bradley | Type CB |
| Is: | All | Resistor, comp., 2.2 K, ±10%, 1/4 W | 1-945000-041 | Allen Bradley | Type CB |

REVISED

APPROVED

| CLASS CODE | | |
|---|---|---|
| THE SINGER COMPANY<br>LOS ANGELES OPERATION<br>LOS ANGELES, CALIF. | TITLE<br>ADDENDUM<br>MODEL TG-1 | DWG. NO.<br>1-500783-261<br>SHEET 2.3 |


92195